

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Preliminary Draft Staff Report
Proposed Rule 1156

PM₁₀ Emission Reductions From Cement Manufacturing Facilities

December 17, 2004

Deputy Executive Officer

Planning, Rule Development, and Area Sources
Elaine Chang, DrPH

Assistant Deputy Executive Officer

Planning, Rule Development, and Area Sources
Laki Tisopulos, Ph.D., P.E.

Director

Planning, Rule Development, and Area Sources
Lee Lockie, M.S.

Author

Minh Pham, P.E. – Air Quality Specialist

Reviewed By

Laki Tisopulos – Assistant Deputy Executive Officer
Lee Lockie – Director
Louis Yuhas – Program Supervisor
John Olvera – Senior Deputy District Counsel

Contributor

Mike Garibay, P.E. – Air Quality Supervisor
Rick Hawrylew, P.E. – Air Quality Engineer II
Brett Kimberly – Air Quality Inspector III
Michael Laybourn – Air Quality Specialist
Edwin Pupka – Senior Enforcement Manager
David Schwien, P.E. – Senior Air Quality Engineer Manager
Mei Wang – Air Quality Engineer II
Mary Woods – Air Quality Specialist

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

GOVERNING BOARD

Chairman: WILLIAM A. BURKE, Ed.D.
Speaker of the Assembly Appointee

Vice Chairman: S. ROY WILSON, Ed.D.
Supervisor, Fourth District
Riverside County Representative

MEMBERS:

MICHAEL D. ANTONOVICH
Supervisor, Fifth District
Los Angeles County Representative

JANE W. CARNEY
Senate Rules Committee Appointee

WILLIAM S. CRAYCRAFT
Council Member, City of Mission Viejo
Cities Representative, Orange County

BEATRICE J. S. LAPISTO-KIRTLEY
Mayor Pro Tem, City of Bradbury
Cities Representative, Los Angeles County/Eastern Region

RONALD O. LOVERIDGE
Mayor, City of Riverside
Cities Representative, Riverside County

JAN PERRY
Councilmember, City of Los Angeles
Cities Representative, Los Angeles County, Western Region

BILL POSTMUS
Supervisor, First District
San Bernardino County Representative

JAMES W. SILVA
Supervisor, Second District
Orange County Representative

CYNTHIA VERDUGO-PERALTA
Governor's Appointee

DENNIS YATES
Council Member, City of Chino
Cities Representative, San Bernadino County

EXECUTIVE OFFICER:

BARRY R. WALLERSTEIN, D.Env.

Table of Contents

EXECUTIVE SUMMARY	1
CHAPTER 1 - BACKGROUND	1
LEGISLATIVE AUTHORITY	1
AFFECTED INDUSTRIES	1
CURRENT REGULATORY REQUIREMENTS	1
DEVELOPMENT OF PROPOSED RULE 1156.....	2
CHAPTER 2 - EMISSION INVENTORY AND REDUCTIONS	3
ANNUAL EMISSION REPORTS AND CONTROL MEASURE BCM-08	3
2004 SURVEY	3
STAFF ESTIMATES OF EMISSION INVENTORY AND REDUCTIONS.....	3
CHAPTER 3 – CONTROL TECHNOLOGY & EMISSION STANDARDS.....	6
EXISTING CONTROL TECHNOLOGIES	6
BAGHOUSE APPLICATIONS	8
OPEN STORAGE PILES & CONVEYING SYSTEM	13
OTHER CONTROL TECHNOLOGIES FOR FUGITIVE EMISSIONS	15
CHAPTER 4 - PROPOSED RULE REQUIREMENTS	16
PERFORMANCE STANDARDS	16
MONITORING, RECORDKEEPING, REPORTING AND SOURCE TESTING REQUIREMENTS	17
CHAPTER 5 – COST EFFECTIVENESS ANALYSIS	18
CHAPTER 6 - IMPACT ASSESSMENT	19
COMPARATIVE ANALYSIS.....	19
ENVIRONMENTAL IMPACT ASSESSMENT.....	19
SOCIOECONOMIC ASSESSMENT.....	19
PRELIMINARY DRAFT FINDINGS REQUIRED BY THE CALIFORNIA HEALTH AND SAFETY CODE	19
REFERENCES.....	21
ATTACHMENTS	25
ATTACHMENT A - REGULATORY COMPARATIVE ANALYSIS	26
ATTACHMENT B – PROCESS DESCRIPTION.....	32
ATTACHMENT C – EMISSION DETERMINATION METHODOLOGY	34
ATTACHMENT D - SOURCE TEST METHODS FOR PM AND PM₁₀	41
ATTACHMENT E - TEST RESULTS FOR KILNS AND CLINKER COOLERS	45
ATTACHMENT F – TEST RESULTS FOR AP-42 EMISSION FACTORS	50
ATTACHMENT G - SURVEY QUESTIONNAIRES.....	53

Executive Summary

Proposed Rule (PR) 1156 – PM10 Emission Reductions from Cement Manufacturing Facilities has been developed to implement a portion of the 2003 Air Quality Management Plan (AQMP) Control Measure BCM-08 – Further Emission Reductions from Aggregate and Cement Manufacturing Operations. PR 1156 has been developed to address the issues related to two cement manufacturing facilities, California Portland Cement Company and Riverside Cement Company, and is scheduled to be adopted in March 2005. Another proposed rule, PR 1157 - PM10 Emission Reductions from Aggregate and Related Operations, has been developed and scheduled to be adopted in January 2005 to address air quality issues related to aggregate and related operations. The PR 1156 and PR 1157, when fully implemented will generate emission reductions and help the region in fulfilling its obligations towards the PM10 State Implementation Plan (SIP), and in achieving attainment of the state and federal PM₁₀ ambient air quality standards.

The two cement manufacturing facilities subject to PR 1156 are significant sources of particulate emissions. California Portland Cement Company is ranked #11, and Riverside Cement Company is ranked #28 on the list of the top 50 particulate emitters in the Basin for 2000-2001. PR 1156 is designed to address particulate emissions generated from all process equipment at these two facilities such as crushers, screens, raw mills, finish product mills, kilns, clinker coolers, storage bins, hoppers etc. as well as fugitive emissions generated from open storage piles and vehicular traffic on paved and unpaved roadways.

Control Measure BCM-08 estimated a total inventory of 1.4 tons per day PM10 for all 75 aggregate and cement manufacturing facilities, and a reduction of 0.7 tons per day PM10 by 2010. The two cement manufacturing facilities subject to PR 1156 contribute approximately 25% of the emission inventory reported in Control Measure BCM-08. Based on current data submitted by the two facilities, staff has estimated an inventory of about 2.5 tons per day PM10 and anticipate a reduction of about 2 tons per day PM10 when PR 1156 is fully implemented. It appears that the emission inventory and reductions in Control Measure BCM-08 are underreported and underestimated.

In order to achieve the anticipated 2 tons per day PM10 reductions from the two cement manufacturing facilities, PR 1156 is designed to:

- Specify an opacity standard of 10% for all operations, except open piles and unpaved roads; and 20% for open piles and unpaved roads;
- Specify specific PM10 emission standard for each process equipment in pounds PM10 per pound of materials processed;
- Specify a PM10 emission standard of 0.05 lb PM10 per ton of clinkers produced for kilns and clinker coolers; or 0.005 grain/dscf measured at the outlet of the kiln/clinker cooler baghouses; or 99.95% control efficiency;

- Specify a performance standard for air pollution control equipment of 99.5% capture efficiency and 99.95% collecting efficiency for baghouses; or an outlet concentration of 0.005 grain/dscf for all baghouses;
- Require enclosure for conveying system, conveying system transfer points, storage areas, crushers, screens, raw mills and finish mills etc. and require venting emissions to air pollution control equipment;
- Require the use of chemical dust suppressants to stabilize the road surface and open piles;
- Require the operator to pave 0.25 mile internal roads leading to public roads; install and operate rumble grates, truck washers, and wheel washers if necessary to reduce truck-out; sweep with Rule 1186 street sweeping; and enforce a vehicle speed limit within the facilities to reduce fugitive road dust; and
- Require the operator to develop and implement rigorous housekeeping procedures.

To ensure that all of the above control measures are implemented appropriately and result in actual emission reductions by 2006, PR 1156 requires the facility to:

- Source test the kilns and clinker coolers annually, and source test the top process emitters which are raw mills and finish mills every 5 years;
- Monitor, record and report (MRR) several pertinent operating parameters of the air pollution control device to ensure continuous compliance with the emission standards; and
- Require the facilities to determine and report their facility emissions from all process equipment, open storage piles, and vehicle traffic on an annual basis.

The incremental cost effectiveness for the PR 1156 is estimated to be about \$2,000 - \$7,000 per ton PM10 reduced.

AQMD staff is seeking input on the cost data and the compliance options; will finalize the cost-effectiveness analyses; complete the Socio-economic and the California Environmental Quality Act (CEQA) analyses; address all comments received; and update the preliminary draft staff report by February 2005.

Chapter 1 - Background

Legislative Authority

The California Legislature created the South Coast Air Quality Management District (AQMD) in 1977 (the Lewis-Presley Air Quality Management Act, Health and Safety Code Section 40400 et seq.) as the agency responsible for developing and enforcing air pollution control rules and regulations in the South Coast Air Basin (Basin). By statute, the AQMD is required to adopt an Air Quality Management Plan (AQMP) demonstrating compliance with all state and federal ambient air quality standards for the Basin (Health and Safety Code Section 40460(a)). In addition, the AQMD must adopt rules and regulations that implement the AQMP (Health and Safety Code Section 40440(a)).

The Proposed Rule 1156 is designed to implement the 2003 Air Quality Management Plan (AQMP) Control Measure BCM-08 – Further Emission Reductions from Aggregate and Cement Manufacturing Operations. The 2003 Control Measure BCM-08 estimated a total inventory of 1.4 tons per day PM10 for all 75 aggregate and cement manufacturing facilities, and a reduction of 0.7 tons per day PM10 by 2010. The two cement manufacturing facilities subject to PR 1156 contribute approximately 25% of the emission inventory and reductions reported in Control Measure BCM-08. This emission reduction is needed to attain the ambient air quality standards for particulate matter. It seems that the emission inventory and reductions in Control Measure BCM-08 are underreported and underestimated.

Affected Industries

Two facilities in the Basin will be affected by the Proposed Rule 1156, California Portland Cement Co. (CPCC) and TXI Riverside Cement (TXI). They are all identified by Source Industrial Code (SIC) 3241.

Current Regulatory Requirements

Attachment A provides a summary of the current rule requirements for cement manufacturing facilities. Currently, there is no AQMD source-specific rule that regulates PM10 emissions from cement manufacturing facilities. Particulate emissions from cement manufacturing facilities are subject to the following existing rules:

- AQMD Rule 401, *Visible Emissions*;
- AQMD Rule 403, *Fugitive Dust*
- AQMD Rule 404, *Particulate Matter - Concentration*;
- AQMD Rule 405, *Particulate Matter - Weight*;
- Federal New Source Performance Standards (NSPS) 40 CFR Part 60, Subpart F, *Standards of Performance for Portland Cement Plants*, and
- Federal National Emission Standards for Hazardous Air Pollutants (NESHAP) 40 CFR Part 63, Subpart LLL, *NESHAP from the Portland Cement Manufacturing Industry*; and

- Federal standards for Monitoring, Recordkeeping and Reporting of Control Equipment in 40 CFR Part 64, *Compliance Assurance Monitoring*.

Development of Proposed Rule 1156

In March 2004, AQMD staff conducted a survey interview to collect the most current information on process equipment, open storage piles, and vehicle traffic at these two cement manufacturing facilities. Attachment G contains the Survey Questionnaires. Staff received most of the information from the facilities in July 2004. From July 2004, AQMD staff has:

- Conducted field visits at the following cement manufacturing facilities: CPCC, TXI in Riverside, National Cement, and CEMEX.
- Reviewed and analyzed the source test results for the kilns and clinker coolers at CPCC and TXI Riverside, the two facilities located in the South Coast Air Basin;
- Researched and contacted EPA and other state agencies to collect information on regulatory approaches, policy, and source test methods underlying the AP-42 emission factors that are currently used to estimate PM10 emissions from the process equipment at the cement industries;
- Researched control technology and contacted vendors for cost information and information on emission data; and
- Estimated emission inventory and emission reductions from data received from the two manufacturing facilities located in the Basin and performed a preliminary cost analysis.

Staff is looking for additional information to refine the current status of equipment at the facilities and the costs of compliance with future standards.

Chapter 2 - Emission Inventory and Reductions

Annual Emission Reports and Control Measure BCM-08

There are two RECLAIM/Title V facilities that are subject to PR 1156, California Portland Cement Company (CPCC) and Riverside Cement Company (TXI) operating within the AQMD's geographic jurisdiction. The total PM emissions reported by these two facilities are 0.36 tpd as shown in their Annual Emission Reports and reflected in the Control Measure BCM-08 of the 2003 Air Quality Management Plan. Fugitive emissions from open storage piles and vehicle traffic were not required to be calculated and therefore were not reported.

2004 Survey

In order to collect current information on 1) process equipment, 2) control equipment, 3) open storage piles, and 4) vehicle traffic at these two facilities, staff visited the two facilities and conducted a survey interview on March 2004. The questionnaires are shown in Attachment G. By July 2004, staff received and analyzed most of the information requested, and proceeded with the development of the preliminary draft staff report and PR 1156.

Staff Estimates of Emission Inventory and Reductions

Based on the information received through the 2004 Survey, staff has completed preliminary estimates of emission inventory and emission reductions. Attachment C, Table C-4 to C-9, contains staff's estimates which will be individually distributed to the facilities. Table 2-1 provides a summary of emission estimates in Table C-4 to C-9 of Attachment C.

Table 2-1
Emission Inventory and Emission Reductions
(Information in this table is under review)

Equipment/Process	Inventory (tpd)		Emission Reductions (tpd)	
	PM	PM10	PM	PM10
Kilns and Clinker Coolers	0.4	0.2	0.2	0.1
Other Processes	1.3	0.6	1.2	0.5
Open Piles	0.03	0.03	0.02	0.01
Vehicle Traffic	6.1 (note)	1.7	4.5 (note)	1.4
<u>Total</u>	7.8	2.5	6	2

Note: Staff has not incorporated control efficiency for existing practices at the facilities.

To estimate emissions for process equipment, staff used the following data:

- List of process equipment from CPCC and TXI Facility Permits;
- Material throughputs provided by CPCC and TXI through the Survey¹;
- Emission factors documented in U.S. EPA AP-42, Chapter 11.6 and other related chapters of AP-42²; and
- Average emission rates for the kilns and clinker coolers from the 1990 – 1997 test results at these facilities.

To estimate emissions for open storage piles, staff used:

- Information on type of materials stored, tonnage of materials stored, dimensions of existing piles, and associated parameters such as moisture content provided these facilities through the Survey; and
- Meteorology information such as wind speed from AQMD database.

To estimate emissions from vehicle traffic, staff used the following information provided by the facilities through the Survey:

- Distances and layout of roadways;
- Average weight of vehicles traveled on the internal roadways; and
- Silt loading and silt content of the internal roadways.

Overall, staff has estimated an inventory of about 7.8 tpd PM and 2.5 tpd PM₁₀, and emission reductions of about 6 tpd PM and 2 tpd PM₁₀:

- For process emissions, staff has estimated about $0.4 + 1.3 = 1.7$ tpd PM, whereas CPCC and TXI reported about 0.36 tpd PM, approximately 5 times higher than their reported inventories. The differences in the two estimates are due mainly to the following reasons:
 - Lower emission factors were used by the facilities. For example, a factor of 0.000025 lb/ton was used for all conveying system, and this factor should only be used for limestone conveying system vented to baghouse achieving at least 99.9% control efficiency. Staff adjusted the AP-42 emission factors appropriately in order to reflect the current status of control equipment at the facilities which are at about 90%-95% efficiency.

¹ For equipment with no throughput data provided by CPCC and TXI, staff made estimation based on process flow diagrams submitted by these two facilities.

² Emission factors in AP-42 generally reflects best performance status of the equipment tested, e.g. 99.9% or higher control efficiency for baghouses. Staff has adjusted these emission factors to reflect the existing conditions at CPCC and TXI.

- The facilities did not estimate emissions for all equipment. For example, they did not account for all conveyors and all transfer points. By using the equipment list generated from the facility permits, staff accounted for all emissions generated at all points at these two facilities.
- The facilities did not report fugitive emissions from their open storage piles and vehicle traffic.

Chapter 3 – Control Technology & Emission Standards

Existing Control Technologies

The operations that generate particulate matter at a cement manufacturing plant are:

- Quarrying, crushing, screening, grinding, milling, and conveying of raw materials;
- Loading and unloading of raw materials to storage including open storage pile, bin, hopper, or storage tank;
- Clinker production and combustion of fuels in kilns and clinker coolers;
- Grinding and milling of clinker into cement;
- Loading and unloading and conveying of cement to and from storage area;
- Product packaging or sacking.

Emissions generated from these operations can be subcategorized into 1) process emissions, and 2) fugitive emissions. Process emissions can be contained in an enclosure and vented to an add-on control equipment. For example, the raw mills and finish mills at CPCC are located in a building with the emissions are vented to a baghouse. Fugitive emissions cannot be contained but can be mitigated and controlled. Examples of fugitive emissions are emissions generated from vehicle traffic traveling within the plant and track-out, or emissions from wind erosion, re-entrainment, and spillage.

An operation may generate both process and fugitive emissions. For example, emissions from an open storage pile include 1) process emissions from loading and unloading activities; and 2) fugitive emissions due to wind erosion, re-entrainment, and vehicle movement within the area.

Attachment C provides a description of each operation at the cement manufacturing facility, a description of the control techniques applicable for each source and the control efficiency; and includes a methodology, equations and assumptions that staff used in estimating the emissions and emission reductions for both process emissions and fugitive emissions. Table 3-1 provides a list of control techniques currently employed at CPCC and TXI.

Table 3-1
Current Control Techniques Employed at CPCC and TXI

Source	Control Techniques
Kilns Clinker Coolers	<ul style="list-style-type: none"> • Baghouses
Crushing Grinding Screening Milling Blending Drying Other Processes	<ul style="list-style-type: none"> • Enclosed and Vented to Baghouses • Wet Suppression

Table 3-1(Cont.)

Source	Control Techniques
Storage Bins Hoppers Tanks Piles	<ul style="list-style-type: none"> • Enclosed and Vented to Baghouses (excluding open piles) • Wet Suppression
Loading Unloading	<ul style="list-style-type: none"> • Enclosed Truck/Railcar Unloading and Vented to Baghouses • Wet Suppression • Techniques to Reduce Freefall Distances (e.g. Transfer Chute)
Conveying	<ul style="list-style-type: none"> • Enclosed and Vented to Baghouses • Wet Suppression • Techniques to Reduce Freefall Distances (e.g. Stack Conveyor)
Vehicle Traffic Roadways	<ul style="list-style-type: none"> • Route Modification (e.g. Paving, Adding Gravel/Slag to Dirt Road) • Dust Suppression Application (Water With /Without Surfactants) • Soil Stabilization • Vehicle Restrictions (e.g. Limit Speed, Limit Number of Vehicles) • Prevention and Street Sweeping • Truck Wash • Covers and Leak Resistant Bottoms On Trucks
Wind Erosion	<ul style="list-style-type: none"> • Enclosure or Wet Suppression
Spillage	<ul style="list-style-type: none"> • Excellent Housekeeping, Leveling of Loads, Tarping

As shown in Table 3-1, most of the process equipment at CPCC and TXI are enclosed and vented to baghouses. CPCC and TXI use wet suppression, street sweeping, truck washing and enforce vehicle speed limits to reduce fugitive emissions. It seems that CPCC and TXI have sufficient knowledge about available control technologies and have applied almost all options to reduce emissions at their facilities. The remaining questions then become how well and to what extent CPCC and TXI have utilized these available control technologies; and what are the standards to evaluate their performance and compliance.

In summary, the ultimate goals of PR 1156 are to:

- Establish performance or emission standards that could be used to evaluate the performance of the control technologies;
- Identify improvement in the existing control technologies that can better its performance; and
- Implement certain criteria to ensure that the facilities have operated these control equipment at their peak performance.

To set appropriate performance/emission standards and to search for improvements in the existing control technology, staff has conducted a research of technical papers, the EPA website, and consulted with various control technology vendors. This Chapter

summarizes these findings on baghouse application, control technologies for open storage piles, conveyors, and fugitive emissions.

Baghouse Applications

✓ Inventory of Baghouses at CPCC and TXI Riverside Cement

Almost all of the operations at CPCC and TXI are enclosed and vented to baghouses. Table 3-2 provides an inventory of 237 baghouses at these two facilities. The top 10 largest baghouses at CPCC and TXI are the baghouses controlling emissions from kilns, clinker coolers, finish mills, and raw mills. The baghouses are either reverse air clean or pulse jet. The typical bag type are conventional woven fiberglass or Nomex for high temperature applications (425 F – 500 F), and polyester or Dacron for low temperature applications (200 F – 300 F).

**Table 3-2
Current Inventory of Baghouses**

California Portland Cement

Source	No of Baghouses	No of Bags	Bag Type
Kilns	2	2352	Fiberglass
Clinker Coolers	2	1216	Nomex
Finish Grinding	2	660	Polyester
Raw Mat Grinding, Sacking	30	200-500	Polyester
Kiln Feed, Product Handling	34	100-200	1-Nomex, 33-Polyester
Rock Storage Area, Rock and Clinker Transfer	55	<100	2-Nomex, 53-Polyester
Unknown	10	-	-
Total	135		

TXI Riverside Cement

Source	No of Baghouses	No of Bags	Bag Type
Finish Mills – Gray Cement	3	1200-1700	Polyester
Finish Mill – Gray Cement	2	700-900	Dacron
Raw Mill – White Cement			
Raw Mill - White Cement, Clinker Hopper	2	600	GoreTex
White Kilns/Clinker Coolers	2	480	Fiberglass
Feed Silos, Packing Area, Finish Mills	6	200-500	Polyester, Dacron
White Clinker Transfer Area	16	100-200	Polyester, Dacron
Rock Storage Area, Rock Silos, Clinker Silos, and Conveying System	30	<100	GoreTex, Polyester, Dacron
Unknown	41		
Total	102		

✓ AQMD Source Tests for Kilns and Clinker Coolers

AQMD has source tested the kiln and clinker baghouses at CPCC and TXI from 1991-1999. Attachment E provides information on the annual test results of the kiln and clinker baghouses at CPCC (Table E-1) and TXI Riverside Cement (Table E-2). These source tests were conducted using AQMD Source Test Method 5.1, 5.2, 5.3, and EPA Method 201A. Table 3-3 summarizes the average and the lowest achieved level for PM based on the information in Attachment E. The PM10 level was estimated from the PM level with an assumption that 50% of the PM was PM10.

Table 3-3
Source Test Results for Kilns and Clinker Coolers

California Portland Cement

	Source	PM Level	PM10 Level
Average of 10 tests	Kiln	0.01 gr/dscf 0.26 lb/ton clinker	0.005 gr/dscf 0.13 lb/ton clinker
Average of 8 tests	Clinker Cooler	0.01 gr/dscf 0.07 lb/ton clinker	0.005 gr/dscf 0.03 lb/ton clinker
Best Achieved Levels (96, 95, 93, 91 Tests)	Clinker Cooler	0.003 – 0.004 gr/dscf	0.001 – 0.002 gr/dscf
Best Achieved Levels (95, 93, 91 Tests)	Kiln	0.003 - 0.005 gr/dscf	0.001 - 0.002 gr/dscf

TXI Riverside Cement

	Source	PM Level	PM10 Level
Average of 6 tests	Kiln/Clinker Cooler	0.02 gr/dscf 0.55 lb/ton clinker	0.01 gr/dscf 0.27 lb/ton clinker
Best Achieved Level (93 Test)	Kiln/Clinker Cooler	0.0055 gr/dscf	0.0027 gr/dscf

✓ U.S. EPA (EPA) Source Tests for Other Equipment

The EPA has used a number of source test results at cement manufacturing facilities to develop AP-42 emission factors, documented in Chapter 11.6 and 11.12 of AP-42, for kilns, primary crushers, secondary crushers and screens, raw mills, finish mills and related equipment vented to baghouses. Attachment F provides information on these test results. The tests were conducted based on EPA Source Test Method 5 and 201A. Table 3-4 summarizes the level of PM measured in these source tests. The level of PM10 was estimated from the PM level assuming 50% of PM was PM10.

Table 3-4
Source Test Results Underlying EPA AP-42 Emission Factors

Source	AP-42 PM Emission Factor (lbs/ton)	PM Level (gr/dscf)	PM10 Level (gr/dscf)
Kilns	0.03 (lbs/ton clinker)	0.002	0.001
Kilns	0.07 (lbs/ton clinker)	0.005	0.003
Raw mill	0.012	0.004	0.002
Raw mill feed belt	0.0031	0.0025	0.001
Raw mill weight hopper	0.019	0.015	0.007
Raw mill air separator	0.032	0.025	0.012
Finish mill	0.008	0.003	0.001
Finish mill feed belt	0.0024	0.0057	0.003
Finish mill weight hopper	0.0094	0.013	0.007
Finish mill air separator	0.028	0.025	0.012
Primary crushing	0.001	0.001	0.0005
Primary screening	0.00022	0.0002	0.0001
Secondary crushing/ screening	0.00031	0.0006	0.0003
Limestone transfer	0.000029	0.0016	0.0005

✓ **U.S. EPA (EPA) Environmental Technology Verification Program and Vendor Information**

The EPA conducts an Environmental Technology Verification (ETV) program for baghouse filtration products. Vendors submit samples of their product to EPA for testing. After EPA verifies the performance of these samples, they issue the vendors a verification report which becomes a valuable marketing tool for the vendors and a useful resource for users. Verification reports can be downloaded from EPA website, www.epa.gov. Since 2001, EPA has verified a total of 11 baghouse filtration products supplied by the following vendors:

Air Purator Corporation	Albany International
BASF Corporation	BHA Group, Inc.
BWF America, Inc.	Inspec Fibres
Menardi-Criswell	Polymer Group, Inc
Standard Filter Corp.	Tetratec
W.L. Gore	

Staff has contacted all the above vendors and received feedback from the vendors listed in Table 3-5. Table 3-5 lists the performance standards achieved and verified by EPA for the high efficiency filters.

Table 3-5
High Efficiency Filtration Products

Vendor	PM10 Performance Standard (grain/dscf)
W.L. Gore	0.004
Menardi-Criswell	0.001
BHA Group, Inc	0.0005
BWF America, Inc	0.0004
Air Purator Corp.	0.0003
Tetratec/Donalson	0.001

In general, conventional filter media includes woven filter bags (fiberglass, polyester) that are used in reverse-air baghouses, and felt filter bags that are used in pulse jet baghouses. Using conventional filter media, filtration occurs as a result of 1) the formation of a primary dustcake (initial layer of dust) on the surface of the filters; and 2) the accumulation of dust particles within the depth of dustcake layer. The conventional filter media acts solely as a support for the primary dustcake layer. The primary dustcake, however, is usually lost during the cleaning cycle and must be reestablished. Without the presence of the primary dustcake, dust particles will bleed through the conventional filters during the cleaning cycle resulting in intermittent emissions called “puffing”.

High efficiency filters act on the concept of surface filtration, which include expanded polytetrafluoroethylene (ePTFE) membranes, or PTFE finishes, bonded to the surface of conventional media. The ePTFE membranes or finishes can be bonded on either woven fiberglass, or woven fabrics, or felts. This layer of membrane reduces the need for primary dustcake and thus eliminates intermittent “puffing” emissions. The collecting efficiency of conventional fiberglass filter is about 99.9%, and 99.993% for fiberglass conventional filter coated with ePTFE. (Polizzi, 1999; Polizzi, 2001; Martin, 2004; Laskaris, 2002).

The significance in emission reductions achieved by switching from conventional filters to high efficiency filters is shown in Table 3-6 assuming that currently all process equipment at CPCC and TXI are vented to baghouses equipped with conventional filters to achieve 99.9% control which results in 1 tpd emissions. By retrofitting with high efficiency filters to achieve 99.95% efficiency, CPCC and TXI can significantly reduce their facility emissions to 0.5 tpd (50% reduction); and with 99.993% control efficiency, they can lower their emissions to 0.07 tpd (93% reduction).

Table 3-6
Collecting Efficiency Versus Emission Reduction

	Control Efficiency	PM10 Emissions (tpd)
Conventional Filter	99.9%	1
High Efficiency Filter	99.95%	0.5
High Efficiency Filter	99.993%	0.07

✓ **Other Technical Information**

Other valuable information related to baghouse performance is listed below:

- The opacity limit of 5% to 10% is specified in operating permits for many cement facilities in California and other states such as Iowa, Indiana and South Dakota.
- The opacity limit of 10% is currently required by NESHAP.
- The European Commission for cement industry in Europe has specified a Best Available Control Standard of 0.008 gr/dscf - 0.012 gr/dscf for dust (European Commission, 1999). Assuming 50% of dust is PM10, a level for PM10 is then approximately 0.004 gr/dscf – 0.006 gr/dscf.
- The Pollution Prevention Directorate Environmental Canada preliminarily recommended a standard of 0.006 grain/dscf or 0.08 lb PM per ton clinker for kilns and 10% opacity for all operations (Canada, 2004). Assuming 50% of PM is PM10, a level for PM10 is then 0.04 lb per ton of clinker.
- Operating data at several cement manufacturing plants show emissions of less than 0.005 grain/dscf such as a cement kiln at Wietersdorf in Austria that achieved from 4 - 7 mg/Nm³ dry ³ (Grabmeyer, 2001), cement kiln at Lafarge Martres, Ciments d'Origny, Cimpor Souselas, Juracime Cement achieved <10 mg/Nm³ (Laskaris, 2002).

✓ **Recommended Performance Standards for Baghouse Applications**

After reviewing all of the above information, staff believes that there are many improvements in the filtration products which can help to increase the collecting efficiency of a baghouse to as high as 99.99% and lower the outlet concentration of a baghouse to 0.0003 gr/dscf or less. To allow for some operational flexibility, staff recommends the following performance standards for PR 1156:

- For kilns and clinker coolers:
 - An outlet emission level of 0.005 gr/dscf; or
 - 0.05 lb/ton clinker for kilns and clinker coolers
- For other processes vented to baghouses:
 - An outlet emission level of 0.005 gr/dscf;
 - 99.95% collecting efficiency for baghouses; or
 - EPA AP-42 emission factor in lb/ton materials transferred or processed for other process equipment

³ Conversion 1mg/Nm³ = 0.0004 grain/dscf.

- For hood and ventilation system:
 - 99.5% capture efficiency; or
 - meet the requirements specified in U.S. Industrial Ventilation Handbook (Martin, 1998) (Industrial, 1986)
- A 10% opacity level for all equipment operating with baghouses.

Open Storage Piles & Conveying System

Emissions from open storage piles or open conveying systems are affected by many factors such as material type, size and characteristics, moisture content, process throughput, operating practices, topographical and climatic factors.

Wet suppression, either by the application of water, chemicals and/or foam watering is currently used at the facilities. However, its control effectiveness (i.e. as long as surface moisture is high enough to cause the fines to adhere to the larger rock particles) depends upon variables that are changeable such as local climate conditions and source properties, or variables that are not easy to verify such as frequency of applying wet suppression, or operator practices. Therefore, wet suppression is useful mainly to reduce the emissions that cannot be contained such as emissions from vehicle traffic and re-entrainment. Even with these fugitive emissions, wet suppression typically has only a temporary effect, and its control efficiency is very subjective.

Enclosing open piles and conveying system blocks the wind and provides permanent control and containment. Its control efficiency is guaranteed, easy to verify, and does not depend on factors such as climate conditions and operator practices. Coupling the enclosure with wet suppression by spraying at the opening of the enclosure eliminates nearly 95% of the emissions.

Enclosed conveying system and domes for raw materials and products are installed and maintained at many cement manufacturing facilities in California such as:

- California Portland Cement in Mohave, Kern County, has a limestone enclosed storage and reclaim system;
- Lehigh Southwest Cement in Tehachapi, Kern County, has a covered quarry conveying system vented to baghouses and an enclosed storage area for a 5-acre of raw materials;
- National Cement in Kern County has a 2.5 miles covered conveyors and enclosed storage area for raw materials and products;
- Southdown California Cement (CEMEX) in Victorville has a primary crusher enclosed and vented to baghouse, and a permit to construct to have all outside conveyors covered;

- TXI Riverside Cement at Oro Grande has an AQMD Permit to Construct to have all conveyors transporting materials from quarry to crushers covered; and
- In addition, Rule 1158 adopted in 1999, has required enclosed storage and enclosed conveying system for facilities that handle and use coke, coal and sulfur in the Basin.

The 1999 staff report for Rule 1158 cited several dome vendors such as Dome Systems, Plas-Steel, and Klimke & Wright LTD. Staff has contacted four additional representative vendors who manufacture and supply concrete, steel or aluminum domes for cement manufacturing facilities. Their applications are summarized in Table 3-7 and can be found in more details from their websites.

Many vendors currently provide enclosed conveyors to cement industry. The staff report for Rule 1158 cited several vendors who supply total enclosed conveyors⁴. Staff has contacted three additional vendors for quotes including Fiberdome; Mertec Engineering which represents Cambelt International Corporation, Kollman, and ASGCO; and Applied Conveyor Technology which represents Martin Engineering.

Table 3-7
Dome Application for Open Storage Piles

Vendor	Dome Application
Dometec	<ul style="list-style-type: none"> • Clinker concrete dome for Ash Grove Cement in Arkansas; • Clinker concrete dome for Essroc Materials in Michigan; • Gypsum, fly ash, and many cement storage domes.
Temcor	<ul style="list-style-type: none"> • Limestone aluminum storage dome for California Portland Cement in Mojave California; • Limestone and cement dome for Lehigh Portland Cement and St. Lawrence Cement in Maryland; • Sand dome for Junction City in Georgia; and • Many other coal and cement storage domes
Consevatek	<ul style="list-style-type: none"> • Cement and limestone aluminum domes for cement plants in Texas and Kansas.
Geometrica	<ul style="list-style-type: none"> • Clinker dome in Canada; • Gravel and copper ore domes in Mexico and Chile; • Coal and limestone aluminum and steel domes in Taiwan, Thailand, Chile and Mexico.

⁴ These vendors supplied 1600 ft covered conveying system for Metropolitan Stevedore, 300 ft covered conveying system for Aimcor, 390 ft covered conveying system for ARCO, 755 ft covered conveying system for Aimcor Main Barn, 1230 ft covered conveying system for ARCO Great Lake, 830 ft covered conveying system for Oxbow, and 875 ft covered conveying system for Chevron.

As demonstrated above, enclosed storage piles and conveying systems are achieved-in-practice, however because the costs of enclosed storage piles are high, staff decided not to require total enclosures for all existing storage piles, and reduced its recommendation to require the following:

- Enclosed conveyors;
- Enclosed storage piles of materials that meet certain emissivity criteria;
- For the remaining open piles, use wet suppression or three-sided enclosure with at least 2-ft of freeboard.

Other Control Technologies for Fugitive Emissions

The technical handbook (Martin, 1998), OSHA Guidelines (OSHA, 1987), and the staff reports for Rule 403, Rule 1158, and Proposed Rule 1157 discuss many other control measures for fugitive emissions such as rumble grates, wheel washers, conveyor skirting, dust curtains, transferring chutes, use of shrouds or enclosures for crushers, screens, bucket elevators, feeders, screw conveyors, pneumatic conveyors, dryers, road paving, reducing traffic speed and volume.

Chapter 4 - Proposed Rule Requirements

The purpose of PR 1156 is to reduce PM₁₀ emissions from all operations at the cement manufacturing facilities. The following is a summary of the proposed requirements.

Performance Standards

PR 1156 requires the following emission standards and performance standards:

Visible Emissions

- ✓ No visible emission exceeding 10% opacity shall be generated from any operation, except open storage piles, paved and unpaved roads;
- ✓ No visible emissions exceeding 20% for open piles, paved and unpaved roads;
- ✓ No 5 consecutive visible emissions more than 50% opacity for open piles, paved and unpaved roads; and
- ✓ No dust plume exceeding 100 feet in any direction from any operations

Kilns and Clinker Coolers

- ✓ Achieve 0.005 grain/dscf measured at outlet of baghouse;
- ✓ 0.05 lbs per ton of clinker produced; or
- ✓ 99.95% control efficiency

Loading, Unloading, and Transferring

- ✓ Meet 0.005 grain/dscf outlet concentration, or end-point emission factor in lb/ton
- ✓ Enclose loading and unloading operations and vent to baghouses
- ✓ Enclose conveyors and transfer points and vent to baghouses
- ✓ Use chemical dust suppressant as needed

Crushing, Screening, and Milling

- ✓ Achieve 0.005 grain/dscf outlet concentration, or specific end-point emission factor in lb/ton for each operation
- ✓ Enclose all crushing, screening, and milling operations and vent to baghouses
- ✓ Use chemical dust suppressant system as needed

Material Storage

- ✓ Achieve 0.005 grain/dscf outlet concentration, or end-point emission factor in lb/ton for each type of material transferred
- ✓ Silos, hoppers, bins, underground storage, and enclosed storage vented to baghouses
- ✓ Enclose all piles higher than 3 ft or greater than 150 square feet that meet certain emissivity criteria
- ✓ For other open piles: a) Use chemical dust suppressant to stabilize the surface, reapply after loading and unloading, or b) Install a three-sided enclosure and stabilize the open-sided area.

Air Pollution Control Device - Baghouses

- ✓ Achieve 0.005 grain/dscf outlet concentration or 99.95% control efficiency
- ✓ Achieve 99.5% capture efficiency or meet minimum duct design velocity in fpm specified in Industrial Ventilation Handbook

Internal Roads

- ✓ For unpaved roadways dedicated to haul trucks: Use chemical dust suppressant to stabilize the surface, and enforce speed limit
- ✓ For other unpaved roadways: Use chemical dust suppressant to stabilize the surface, pave, or apply gravel.
- ✓ For paved roads: Sweep with Rule 1186 certified sweepers at least once a day to achieve opacity standards.

Track-Out

- ✓
- ✓ Pave 0.25 mile of roads leading to public roads
- ✓ Cover all open-bed truck loads before leaving facility, or use at least 6 inches of freeboard
- ✓ Distribute “Fugitive Dust Advisory” information to truck companies

Facility Cleanup

- ✓ Conduct good housekeeping

Monitoring, Recordkeeping, Reporting and Source Testing Requirements

- ✓ Require the operator to monitor, record and report (MRR) pertinent operating parameters of control devices such as pressure drop across the baghouses and flue gas flow rates to assure continuous compliance with the emission rates.
- ✓ Require the operator to conduct source testing annually for kilns and clinker coolers; and every 5 years for other 10% of the baghouses at the facility which control emissions from the top 20% process emitters.
- ✓ Require the operator to use a combination of AQMD Source Test Method 5.1, 5.2 and 5.3 and U.S. EPA Source Test Method 201A to measure PM10 emissions. EPA Source Test Method 5 shall be allowed as appropriate. The source tests described in AQMD Rule 403 Implementation Guidance Docume shall be used to measure moisture content, silt content and silt loading. EPA Opacity Test Method 9 and AQMD Opacity Test Method 9B shall be used to determine opacity.
- ✓ Require the operator to report filterable and condensable PM10 measured with appropriate source test methods; to report all emissions including process emissions, emissions from vehicle traffic and open storage piles on and annual basis; and to maintain all records to demonstrate compliance for at least 5 years.

Chapter 5 – Cost Effectiveness Analysis

Staff has estimated a preliminary cost effectiveness for PR 1156 based on the following assumptions:

- Costs for replacing conventional filters with high efficiency filters are \$1.5 million for each facility every 5 years, assuming the costs for high efficiency filters are 2 or 3 times higher than the costs for conventional filters.
- Capital costs for installing domes for all open storage piles at the two facilities are \$21 million, assuming an average cost of \$30 - \$37 per square feet for 55ft – 500 ft dome.
- Additional capital costs for enclosed conveying system are \$1.3 million, assuming there would be a total of 1,300 ft of open conveyors need to be retrofitted at a cost of \$1,000 per foot.
- Capital costs for enclosed transfer points are \$1.6 million, assuming each facility needs to enclose additional 10 transfer points and the cost for each enclosed transfer point is \$80,000.
- Additional annual costs for source testing and facility cleanup at each facility are \$100,000.

Staff has performed a “sensitivity” cost analysis containing three scenarios with emission reductions ranging from 0.6 tpd to 2 tpd. The 0.6 tpd reduction represents the reduction received from process equipment, and the 2 tpd reduction represents the reduction from process equipment, vehicle traffic and roadways. The total compliance costs are assumed to be identical in three scenarios. With the above costs and assumptions, the overall cost effectiveness of PR 1156 is estimated to be about \$2,000 – \$7,000 per ton PM10 reduced.

Table 5-1
Cost Effectiveness for PR1156

	Scenario 1	Scenario 2	Scenario 3
	All control measures & 2 tpd reductions	All control measures & 1 tpd reductions	All control measures & 0.6 tpd reductions from process equipment only
Present Worth Value (PWV) for Enclosed Primary Crusher	200,000	200,000	200,000
PWV for Enclosed Conveyors & Transfer Points	2,900,000	2,900,000	2,900,000
PWV for Baghouses (\$3 Million Every 5 Years)	11,652,900	11,652,900	11,652,900
PWV for Enclosed Storage Piles	21,335,000	21,335,000	21,335,000
PWV for Housekeeping & Testing	3,124,400	3,124,400	3,124,400
Total Present Worth Value (25-years)	39,212,300	39,212,300	39,212,300
Total PM10 Emission Reduction in 25 Years (tpd)	2.00	1.21	0.6
Rule Cost Effectiveness (\$/ton PM10 reduced)	2,149	3,551	7,162

Chapter 6 - Impact Assessment

Comparative Analysis

Under the Health and Safety Code Section 40727.2, the AQMD is required to compare and analyze PR 1156 with existing state or federal regulations. This analysis will be available in the set hearing package.

Environmental Impact Assessment

Pursuant to the California Environmental Quality Act (CEQA) and AQMD Rule 110, appropriate CEQA documentation will be prepared for PR 1156. Comments received on the preliminary draft staff report will be considered when evaluating the potential for adverse environmental impacts for the proposal.

Socioeconomic Assessment

AQMD staff is preparing a Socioeconomic Assessment which will be available in the set hearing package of the PR 1156. AQMD staff is seeking input regarding the cost data. The cost-effectiveness and the incremental cost-effectiveness associated with the implementation of the PR 1156 will be assessed in details in the set hearing package.

Preliminary Draft Findings Required by the California Health and Safety Code

Under the Health and Safety Code Section 40727, the AQMD's Governing Board is required to make findings of necessity, authority, clarity, consistency, nonduplication, and reference before adopting a rule, such as Proposed Rule 1156. Staff expects the following:

Necessity: The AQMD's Governing Board will determine that a need exists to adopt PR 1156 to implement Control Measure BCM-08 in the 2003 AQMP.

Authority: The AQMD will find and obtain its authority to adopt, amend or repeal rules and regulations from Sections 39002, 40000, 40001, 40440, 40702, and 41508 of the California Health and Safety Code.

Clarity: The AQMD's Governing Board will find and determine that PR 1156 as proposed to be adopted is written or displayed so that its meaning can be easily understood by the persons directly affected by it.

Consistency: The AQMD's Governing Board will determine that the PR 1156 as proposed to be adopted is in harmony with, and not in conflict with or contradictory to, existing statutes, court decisions, or state or federal regulations.

Nonduplication: The AQMD's Governing Board will determine that the PR 1156 as proposed to be adopted does not impose the same requirements as any existing state or federal regulation.

Reference: The AQMD's Governing Board in adopting the PR 1156 will reference the following statutes which the AQMD hereby implements, interprets, or makes specific: Title 42 U.S.C. Section 7411 (performance standards for new stationary sources), Health and Safety Code Sections 40001(b) (air quality standards), 40440(a) (rules to carry out plan), and 40702 (adopt regulations to execute duties).

References

ACT, 2004. Applied Conveyor Technology. Communications with Mr. Edward Sunseri. www.groupact.com

APC, 2004. Air Purator Corporation. Communications with Mr. Mike Swink. www.HighTempFelt.com

AQMD, 1989. *AQMD Source Test Manual*, March 1989.

- Method 5.1
- Method 5.2, *Determination of Particulate Matter Emissions from Stationary Sources Using Heated Probe and Filter*
- Method 5.3, *Determination of Particulate Matter Emissions from Stationary Sources Using An In-Stack Filter*

AQMD, 1993. *CEQA Air Quality Handbook, Chapter 9 – Emission Calculation Procedures*.

AQMD, 1999. *Rule 1158 and Staff Report - Storage, Handling and Transport of Coke, Coal, and Sulfur*, June 1999.

AQMD, 2004. *Proposed Rule 1157 and Staff Report – PM10 Emission Reductions for Aggregate and Related Operations*, November 2004

BHA, 2004. BHA Group, Inc., www.bhagroup.com

- Brochures 1) *Product Highlight, BHA-TEX Laminated to 100% PTFE Base Fabric*; 2) *Test Results Confirm BHA-TEX ePTFE Membrane #1*; 3) *BHA-TEX ePTFE Membrane Filters*; 4) *Advanced TEXnology*; 5) *MAX-9 Electrostatic Fabric Filter*; and.
- Communications with Mr. Andy Winston.

BWF, 2004. BWF America, Inc., www.bwf-america.com.

- Brochures 1) *MicroPore Size (MPS) High Efficiency Felts*; 2) *CS-18 High Temperature PTFE Surface Coating*; 3) *Technical Treatments for Felts*; 4) *Various Other Company Brochures*;
- Communications with Mr. Clint Scoble.

Canada, 2004. *Draft Foundation Report on the Cement Manufacturing Sector*. Minerals and Metals Branch Pollution Prevention Directorate Environment Canada, June 18, 2004.

Conservatek, 2004. www.conservatec.com.

- Brochure: *Aluminum Roof Systems for Bulk Storage Facilities*,
- Communications with Mr. Larry Wood and Ms. Nita Bailey.

CPCC, 2004. www.calportland.com. *Information Submitted by California Portland Cement Company Responding to AQMD 2004 Survey*, March – July 2004

Donalson, 2004. Communications with Mr. Bob Walters. www.donalson.com

Domtec, 2004. Communications with Mr. Mike Hunter. www.domtec.com.

EPA, 1983. *Estimation of the Importance of Condensed Particulate Matter to Ambient Particulate Levels*, U.S. EPA, NTIS PB84102565, April 1983.

EPA, 1991A. *40 CFR Part 51, Preparation, Adoption, and Submittal of State Implementation Plans, Method for Measurement of Condensable Particulate Emissions from Stationary Sources, Final Rule*, Federal Register, Volume 56, No. 242, Page 65433-38, December 1991.

EPA, 1991B. *Method 201A, Determination of PM₁₀ Emissions - Constant Sampling Rate Procedures*, U.S. EPA, 40 CFR Part 51, Appendix M, 1991.

EPA, 1991C. *Method 202, Determination of Condensable Particulate Emissions from Stationary Sources*, U.S. EPA, 40 CFR Part 51, Appendix M, 1991.

EPA, 1992. *Fugitive Dust Background Document & Technical Information Document for Best Available Control Measures*, EPA-450/2-92-004, September 1992.

EPA, 1995A. *Compilation of Air Pollutant Emission Factors, 5th Edition, Volume I: Stationary Points and Area Sources*, AP-42.

- Chapter 11.6, *Portland Cement Manufacturing*, January 1995
- Chapter 11.12, *Concrete Batching*, October 2001
- Chapter 11.19.2, *Crushed Stone Processing and Pulverized Mineral Processing*; August 2004
- Chapter 13.2.4, *Aggregate Handling and Storage Piles*; January 1995
- Chapter 13.2.5, *Industrial Wind Erosion*, January 1995
- Appendix C.1, *Procedures for Sampling Surface and Bulk Dust Loading*, July 1993.

EPA, 1995B. Supporting Source Test Information for AP-42 Emission Factors, including the following source tests:

- *Air Pollution Emission Test at Arizona Portland Cement*, June 1974
- *Performance Guarantee Testing at Southwestern Portland Cement*, February 1985
- *Compliance Testing at Southwestern Portland Cement*, April 1985
- *Emissions from Dry Process Raw Mill and Finish Mill Systems at Ideal Cement Company, New Mexico*, April 1972
- *PM₁₀ Emission Factors for a Stone Crushing Plant Tertiary Crusher and Vibrating Screen*, December 1992
- *PM₁₀ Emission Factors for Two Transfer Points at A Granite Stone Crushing Plant*, January 1994

- *Final Test Report for USEPA Conducted at Chaney Enterprises Cement Plant Waldorf, Maryland*, February 1994
- *Final Test Report for U.S. EPA Test Program Conducted at Concrete Ready Mixed Corporation Roanoke, VA*, April 1994.

EPA, 1998. *Stationary Source Control Techniques Document For Fine Particulate Matter*. EPA-452/R-97-001. October 1998.

EPA, 2003. *Emission Factor Test Protocol for Ready Mixed Concrete Foundation (Test for Capture Efficiency)* Air Control Techniques. October 2003

EPA, 2004. *Environmental Technology Verification (ETV) of Air Pollution Control Technologies, Baghouse Filtration Products*. www.epa.gov

European Commission, 2001. *Integrated Pollution Prevention and Control (IPPC) – Reference Document on Best Available Techniques in the Cement and Lime Manufacturing Industries*. December 2001.

Fiberdome, 2004. Communications with Mr. Rick Wollin. www.fiberdome.com

Geometrica, 2004. Communications with Mr. Francisco Castano. www.geometrica.com.

GoreTex, 2004. Communications with Mr. Chris Polizzi. www.gore.com

Grabmeyer, 2001. *Dusting Down Kilns*, Grabmeyer J. of Wietersdorfer & Peggauer & Kurt Hofer, Scheuch, International Cement Review, February 2001.

Industrial, 1986. *Industrial Ventilation, A Manual of Recommended Practice*, 19th Edition, 1986.

Laskaris, 2002. *Dedusting Options*. Laskaris, M.A., World Cement, February 2002.

Martin, 1998. *Foundations, The Pyramid Approach to Control Dust and Spillage from Belt Conveyors*. Martin Engineering, 1998.

Martin, 2004. *Fine Filtration Fabric Options Designed for Better Dust Control and to Meet PM2.5 Standards*. T. Martin of BHA Group Inc., 2004.

Menardi-Criswell. Communications with Mr. Dan Eicher. www.menardifilters.com

Mertec Engineering, 2004. www.mertec.net

- Brochures 1) Cambelt www.cambelt.com; 2) Kolman www.kolman.com; and 3) ASGCO, Complete Conveyor Solutions, www.asgco.com
- Communications with Mr. Roger Riccardi of Mertec Engineering, representative of Cambelt, Kolman and ASGCO in California.

OAQPS, 1995. *Chapter 5 - Baghouses. Office of Air Quality Planning and Standards (OAQPS) Control Cost Manual*. Fifth Edition. EPA-453/B-96-001. February 1996.

OSHA, 1987. *Dust Control Handbook for Minerals Processing, Chapter 2 – Preventing Dust Formation. OSHA Guidelines*. February 1987. www.osha.gov

Polizzi, 1999. *Optimizing Kiln Operation by Improving Baghouse Performance*. Polizzi C. and Darrow J. of W.L. Gore & Associates and Cooper G. of Giant Cement Company.

Polizzi, 2001. *Filter Bag Guarantees*. Polizzi C. of W.L. Gore & Associates, World Cement May 2001.

STAPPLA, 1996. *Controlling Particulate Matter Under the Clean Air Act: A Menu of Options*, State and Territorial Air Pollution Program Administrators (STAPPA) and Association of Local Air Pollution Control Officials (ALAPCO), July 1996.

Temcor, 2004. Communications with Mr. George Morovich and Dan Sickafoose. www.temcor.com

TXI, 2004. *Information Submitted by Riverside Cement Company Responding to AQMD 2004 Survey*. March, 2004

Attachments

Attachment A - Regulatory Comparative Analysis

A brief description of current regulatory requirements for Portland cement manufacturing industry is as follows.

- **AQMD Rule 401**

AQMD Rule 401, *Visible Emissions*, establishes limits for visible emissions from operations located in the Basin. Under the rule, a person shall not discharge into the atmosphere from any single source any air contaminant for a period or periods aggregating more than three minutes in any one hour which exceed a Ringelman No. 1 or 20% opacity.

- **AQMD Rule 403**

AQMD Rule 403, *Fugitive Dust*, sets performance standards and operational requirements (Best Available Control Measures, BACM) for any activity capable of generating fugitive dust in the Basin. Under the rule, a typical operation must not emit any visible dust beyond the property line, or the dust generated must not exceed 20% opacity if the dust emissions are generated from vehicle traffic, and PM10 concentration as the difference between upwind and downwind samples must not exceed 50 micrograms per cubic meter. In addition, Rule 403 requires several BACM such as installing 50 ft long gravel, paving 100 ft track-out road, or utilizing wheel washers.

- **AQMD Rule 404**

AQMD Rule 404, *Particulate Matter - Concentration*, specifies maximum allowable particulate concentrations at different discharged gas rates calculated as dry gas at standard conditions. Standard conditions are defined in AQMD Rule 102 as a gas temperature of 60 °F and a gas pressure of 760 mmHg (14.7 lbs/in²) absolute. The smallest and highest maximum concentrations specified in Rule 404 are 0.01 grain/ft³ for discharge rates at or more than 2,472,000 ft³/min; and 0.196 grain/ft³ for discharge rates at or below 883 ft³/min, respectively. For a typically high level of kiln/clinker cooler discharged rate at 150,000 ft³/min dry at standard conditions, the maximum allowable concentration under AQMD Rule 404 would be about 0.02 grain/ft³.

- **AQMD Rule 405**

AQMD Rule 405, *Solid Particulate Matter - Weight*, specifies maximum allowable mass emissions of particulate matter at different process weight per hour. The highest maximum allowable emission rate specified in Rule 405 is 30 lbs/hr for process weight at or more than 1,102,000 lbs/hr. For a typically high level of kiln/clinker cooler feed rate of 80 tons/hr or 160,000 lbs/hr, the allowable emission limit under AQMD Rule 405 would be 19 lbs/hr.

- **AQMD Rule 1112.1**

AQMD Rule 1112.1, *Emissions of Particulate Matter from Cement Kilns*, specifies the maximum allowable mass emissions of particulate matter for gray cement kilns and clinker coolers only. The maximum allowable mass limits are:

- 0.4 lbs/ton of kiln feed for kiln feed rates less than 75 tons/hr, and
- 30 lbs/hr for kiln feed rates equal to or more than 75 tons/hr.

Gray cement kilns and clinker coolers located at California Portland Cement Company are subject to Rule 1112.1 and are exempt from the requirements of Rule 404 and 405. The white cement kilns and clinker coolers at Riverside Cement Company are exempt from Rule 1112.1, and thus are subject to the requirements in Rule 404 and Rule 405.

- **NSPS Title 40, Part 60, Subpart F**

Title 40, Part 60, Subpart F of the Code of Federal Regulations, *Standards of Performance for Portland Cement*, specifies the emission limits for PM from California Portland Cement Plants constructed or modified after August 17, 1971. The requirements of 40 CFR Part 60, Subpart F, are summarized in Table A-1.

- **NESHAP Title 40, Part 63, Subpart LLL**

The 40 CFR Part 63, Subpart LLL, *National Emission Standards for Hazardous Air Pollutants from the Portland Cement Manufacturing Industry*, specifies the standards for new and existing major sources of PM₁₀ (e.g. emissions equal to or more than 70 tpy) at Portland cement manufacturing plants. The requirements of 40 CFR Part 63, Subpart LLL, are summarized in Table A-1.

- **Compliance Assurance Monitoring, 40 CFR Part 64**

Compliance Assurance Monitoring, 40 CFR Part 64, specifies monitoring, recordkeeping, and reporting requirements for sources that are subject to emission standards identified in State Implementation Plan, use a control equipment, and have pre-control emissions that are equal to or more than the major source threshold which is 70 tons/yr for PM₁₀. The requirements of 40 CFR Part 64 are summarized in Table A-1.

- **Comparative Analysis**

Under the Health and Safety Code Section 40727.2, the AQMD is required to compare and analyze PR 1156 with existing state or federal regulations. Table A-1 provides a summary of key requirements in existing AQMD Rule 1112.1, and federal regulations 40 CFR Part 60, Subpart F; 40 CFR Part 63, Subpart LLL; and 40 CFR Part 64; and a

comparison with the proposed requirements in PR 1156 . Further analysis, if needed, will be available in the draft staff report.

Table A-1: Comparison Between PR1156, NSPS 40 CFR Part 60 Subpart F, NESHAP 40 CFR Part 63 Subpart LLL, and Compliance Assurance Monitoring 40 CFR Part 64 Requirements

PROPOSED RULE 1156	AQMD RULE 1112.1	NSPS -- 40CFR PART 60 SUBPART F	NESHAP -- 40 CFR PART 63 SUBPART LLL	COMPLIANCE ASSURANCE MONITORING 40CFR PART 64
APPLICABILITY				
<u>Equipment/Operation:</u> Kiln, clinker cooler, raw mill system, finish mill system, raw mill dryer, raw material storage, clinker storage, conveyor transfer points, bagging, bulk loading and unloading systems; and operations that generate fugitive dusts.	<u>Equipment/Operation:</u> Cement kiln and clinker cooler for dry-process manufacturing of gray cement.	<u>Equipment/Operation:</u> Kiln, clinker cooler, raw mill system, finish mill system, raw mill dryer, raw material storage, clinker storage, conveyor transfer points, bagging and bulk loading and unloading systems <ul style="list-style-type: none"> Equipment constructed or modified after 7/17/1971. 	Facility is a major source or area source of air toxics; <u>Equipment/Operation:</u> Kiln, clinker cooler, raw mill system, finish mill system, raw mill dryer, raw material storage, clinker storage, conveyor transfer points, bagging and bulk loading and unloading systems <ul style="list-style-type: none"> Existing equipment or equipment constructed or reconstructed after 9/11/1998. 	Equipment that: <ul style="list-style-type: none"> is subject to emission standard (e.g. SIP approved rules but not 40 CFR Part 60 or Part 63 rules); uses a control device, and 3) has pre-control emissions that are equal to or more than the major source threshold (e.g. 70 tpy PM10)
COMPLIANCE DATE				
By December 2006.	On and after February 1986.	On or after completion of the initial performance test.	<ul style="list-style-type: none"> For existing equipment: 6/14/2002 For new or modified equipment: Upon startup 	If the Title V application is complete before 4/20/1998, a CAM plan is due as part of the application for the Title V permit renewal, or as part of the application for a significant permit revision.

Table A-1 (Cont.)

PERFORMANCE STANDARDS				
<u>All Equipment</u> Opacity $\leq 10\%$ <u>Kilns and Clinker Coolers</u> PM ₁₀ ≤ 0.05 lb/ton clinker <u>All Baghouses</u> Outlet concentration ≤ 0.005 grain/dscf ; or 99.5% capture efficiency and 99.5% collecting efficiency <u>Other Equipment</u> Equipment specific emission standards in lbs per ton materials processed <u>Other Requirements</u> <ul style="list-style-type: none"> Enclosed storage piles, crushers, screens, mills, conveying systems, and other equipment. Pave roads, use chemical dust suppressants, limit vehicle speed, street sweeping, and facility cleanup. <u>Facility Emissions</u> Reduce 2003 baseline emissions by 50% by 2006.	<u>Kilns and Clinker Coolers Combined</u> <ul style="list-style-type: none"> PM ≤ 0.4 lb/ton feed when kiln feed rates < 75 ton/hr PM ≤ 30 lb/hr when kiln feed rates > 75 ton/hr 	<u>Kilns</u> <ul style="list-style-type: none"> PM ≤ 0.3 lb/ton feed dry basis Opacity $\leq 20\%$ <u>Clinker Coolers</u> <ul style="list-style-type: none"> PM ≤ 0.1 lb/ton feed dry basis Opacity $\leq 10\%$ <u>Other Equipment</u> Opacity $\leq 10\%$	<u>Kilns:</u> <ul style="list-style-type: none"> PM ≤ 0.3 lb/ton feed dry basis Opacity $\leq 20\%$ <u>Clinker Coolers</u> <ul style="list-style-type: none"> PM ≤ 0.3 lb/ton feed dry basis Opacity $\leq 10\%$ <u>Other Equipment</u> Opacity $\leq 10\%$ <u>Other Requirements</u> THC < 50 ppmvd as propane corrected to 7% oxygen D/F $< 8.7 \times 10^{-11}$ grain/dscf corrected to 7% oxygen	Not specified performance standards.

Table A-1 (Cont.)

MONITORING, RECORDKEEPING AND REPORTING REQUIREMENTS				
<ul style="list-style-type: none"> Annual source testing for kilns and clinker coolers Source test at least 10 equipment vented to baghouses which are in the top 20% PM10 emitters at the facility. Monitor operating parameters of baghouses such as flue gas flow rates and pressure drop across filters. Keep all records to demonstrate compliance for at least 5 years. Report annual emissions for all process equipment, open storage piles and vehicle traffic. Source Test Methods: AQMD Method 5.1, 5.2, 5.3 or EPA Method 5 modified; or EPA Method 201A and 202 for PM10. 	Not specify.	<ul style="list-style-type: none"> Continuous opacity monitoring for kilns and clinker coolers and any bypass Record visible emissions at least three 6-minute periods each day, and records maintained for 2 years. Record daily production rates and kiln feed rates Initial performance test is required to be conducted. Excess emissions must be reported semi –annually. Malfunctions must be reported. Semiannual report of excess emissions and malfunctions Source Test Methods: EPA Method 5 for PM and Method 9 for opacity. 	<ul style="list-style-type: none"> Initial performance test is required to determine compliance with the emission limitation and to establish the operating limits Performance test is required every 30 months – 5years Source Test Methods: EPA Method 5 for PM and Method 9 for opacity. 	<p>A CAM plan accompanying a Title V permit must:</p> <ul style="list-style-type: none"> Describe indicators to be monitored; Describe indicators' ranges; Describe performance criteria for monitoring; Provide justification for the use of the indicators, ranges, and monitoring approach; Provide emission test data, if necessary; and Provide an implementation plan. <p>A Title V permit must:</p> <ul style="list-style-type: none"> Include approved monitoring approach, Have specific definitions of exceedence or excursion; Include reporting and recordkeeping requirements; and Indicate if source testing is required. <p>Source Test Methods: Not specified.</p>

Attachment B – Process Description

There are two Portland cement manufacturing facilities in the Basin, California Portland Cement Company (CPCC) and TXI Riverside Cement Company (TXI). CPCC manufactures gray cement, and TXI manufactures white cement and produces gray cement from clinkers delivered to the facility by railcar. The production of Portland cement is a four step process which includes:

- 1) Raw materials acquisition;
- 2) Preparation of raw materials into raw mix;
- 3) Pyroprocessing of raw mix to make clinkers; and
- 4) Grinding and milling of clinkers into cement.

Raw Materials Acquisition

Raw materials for manufacturing cement include calcium, silica, alumina and iron. Calcium is the element of highest concentration, and iron is raw material for gray cement but not used for white cement. These raw materials are obtained from minerals such as limestone for calcium; sand for silica; shale and clay for alumina and silica. CPCC obtains limestone from the quarry located on site. Other raw materials are delivered to CPCC by truck or rail car. All raw materials are delivered to TXI by truck or rail car.

Preparation of Raw Materials into Raw Mix

Preparing the raw mix includes crushing, milling, blending and storage. Primary, secondary and tertiary crushers are used to crush the raw materials until they are about $\frac{3}{4}$ inch or smaller in size. Raw materials are then conveyed to rock storage silos. Belt conveyors are typically used for this transport. From the rock storage silos, the raw materials are conveyed to roller mills or ball mills where they are blended and pulverized into a very fine powder. Pneumatic conveyors are typically used to transport the fine raw mix to homogenizing silos where they are again thoroughly blended and stored until it is fed to the kilns.

Pyroprocessing of Raw Mix

Pyroprocessing is the chemical and physical process of transforming the fine raw mix into clinkers. Pyroprocessing occurs in a rotary kiln and includes three steps:

- Evaporating free water and dehydrating to form oxides of silicon, aluminum, and iron. This process occurs in a drying and preheating zone of the rotary kiln at temperatures of about 212 °F – 800 °F;
- Calcining of calcium carbonates (CaCO_3) to form calcium oxides (CaO) and carbon dioxide (CO_2). This process occurs in the calcining zone of the rotary kiln at temperatures of about 1100 °F – 1800 °F; and

- Chemical reacting, melting and restructuring of materials occur between calcium oxides (CaO), silica, alumina and iron to form clinker which is a solid material ranges in size from 1 inch – 2 inch diameter and contains four major compounds tricalcium silicate (~50% by weight), dicalcium silicate (~25% by weight), tricalcium aluminate (~10% by weight) and tetracalcium aluminoferrite (~10% by weight). The process of forming clinker occurs in the “burning” zone of the rotary kiln at temperatures of about 2200 °F – 2700 °F.

The pyroprocessing process at CPCC and TXI is called a “long dry process” consisting solely of a simple long rotary kiln. CPCC operates two rotary kilns in parallel, each is about 18 ft in diameter and 500 ft in length, to produce grey clinker. TXI operates two rotary kilns in parallel, each is about 12 ft in diameter and 200 ft in length for white clinker. The kiln is slightly inclined and rotates on its longitudinal axis. Raw materials are fed into the upper end of the kiln while fuels are burned in the lower end. As the kiln rotates, the raw materials move slowly from the upper end to the lower end, and the combustion gases move in countercurrent direction. The residence time of raw materials in a gray cement kiln is about 2 hours – 3 hours, whereas for white cement kiln, it is about 8 hours. The hot clinker, which exits at about 2000 °F from the kiln, is quickly cooled in the clinker cooler and is conveyed to storage. Clinker is water reactive and must be stored such that it is protected from moisture. If clinker gets wet, it will hydrate and set into concrete. Heat used in the kiln is supplied through the combustion of different fuels such as coal, coke, oil, natural gas, and even tires. The combustion gases are vented to baghouse where dusts are collected. Dusts returned to the process or recycled if they meet certain criteria, or is discarded to landfills.

Grinding and Milling Clinkers into Cement

Grinding and milling clinkers into cement is the last step of the manufacturing process. Up to 5% of gypsum is added to the clinker during grinding to control the setting time of cement. Other specialty chemicals are also added at this stage. After grinding and milling into fine powder, the cement is pneumatically conveyed to the product silos. The product is either sold in bulk or is bagged.

(Reference: EPA, 1995A and CPCC, 2004)

Attachment C – Emission Determination Methodology

Emission Sources and Emission Factors

The operations that generate particulate matter at a cement manufacturing plant are:

1. Quarrying;
2. raw material crushing, screening, grinding and milling;
3. raw material loading and unloading to storage including open storage pile, bin, hopper, or storage tank;
4. clinker production and combustion of fuels in kiln and clinker cooler;
5. product grinding and milling;
6. product loading and unloading to and from storage area;
7. raw material and product conveying system and transfer point; and
8. product packaging.

Emissions from each operation listed above can be subcategorized into 1) process emissions and 2) fugitive emissions. Process emissions can be contained in an enclosure and vented to an add-on control equipment. Examples of process emissions are emissions from milling and grinding operations vented to a baghouse. Fugitive emissions cannot be contained. Examples of fugitive emissions are emissions generated from vehicle traffic traveling within the plant, or emissions from wind erosion, re-entrainment, and spillage.

An operation may generate both process and fugitive emissions. For example, emissions from an open storage pile include 1) process emissions from loading and unloading activities, and 2) fugitive emissions due to wind erosion, re-entrainment, and traffic traveling within the area.

The following paragraphs provide 1) a description of the emission sources at each operation in a cement manufacturing facility; 2) a description of the control techniques applicable for each source and the control efficiency; and 3) methodology, equations and assumptions used in estimating emissions and emission reductions.

The information is summarized in Table C-1, C-2, and C-3. Table C-1 provides a list of emission sources at cement manufacturing facility; Table C-2 provides a list of control techniques; and Table C-3 summarizes the uncontrolled and controlled emission factors for each source.

- ***Quarry Operation***

Emissions from quarry operation are due mainly to blasting, open storage piles, loading and unloading, wind blowing, and re-entrainment of settled dust by wind and mechanical disturbance, vehicle traffic, or machine movement.

Factors affecting emissions at the quarry site include stone size and distribution, surface moisture content, blasting technique, material blasted, size of blasted areas, blasting frequency, type of equipment and operating practices, and topographical and climatic factors.

Uncontrolled emission factors for blasting operations have not yet been developed. The emissions from quarry operation are small compared to other process equipment at the cement manufacturing plants.

Wet suppression is a control technique for particulate emissions at the quarry sites.

- ***Crushing, Screening, Blending, Grinding, Milling, Combusting of Fuels, and Pyroprocessing***

Particulate emissions from these operations are due mainly to the process of crushing, screening, blending, grinding, milling, material conveying, material loading/unloading and combusting of fuels and pyroprocessing.

Fugitive dust sources in these areas are due mainly to wind, spillage, re-entrainment of settled dust by wind or traffic and machine movement.

Factors affecting emissions include stone type, stone size and distribution, moisture content, process throughput, crusher or screen type, operating practices, and topographical and climatic factors.

Control techniques for these operations are wet suppression and add-on control such as baghouse. Uncontrolled and controlled emission factors are listed in AP-42, Chapter 11.6, 11.19.2, 13.2.2, 13.2.4 and are summarized in Table C-2.

- ***Storage and Handling***

Emissions from material storage and handling includes emissions from loading and unloading of materials, wind erosion of materials from open storage pile, and traffic activity that causes ground material near the open storage pile to be crushed into airborne silt.

These emission sources are affected by material type, size and characteristic, moisture content, process throughput, type of storage (enclosed or covered or open), operating practices, and topographical and climatic factors.

Enclosing the open pile blocks the wind. Coupling the enclosure with wet suppression by spraying at the opening of the enclosure eliminates nearly 95% of the emissions.

Wet suppression (e.g. application of water, chemicals and/or foam watering) is useful mainly to reduce emissions from vehicle traffic and re-entrainment in the open storage pile area. Wet suppression typically has only a temporary effect on total emissions and

the control efficiency depends upon variable parameters such as local climate conditions, source properties, duration of control effectiveness (i.e. as long as surface moisture is high enough to cause the fines to adhere to the larger rock particles), and frequency of applying wet suppression.

- ***Conveying***

Particulate emissions occur when materials are transferred between process operations. Wind erosion and spillage are the cause of fugitive emissions from open or partially enclosed conveyors. Materials are spilled off of the conveyors and become airborne by wind. Emissions are affected by material type, material size and characteristic, moisture content, process throughput, conveyor type and drop operation, operating practices, and topographical and climatic factors.

Enclosed conveyors, and add-on control equipment such as baghouses at transfer points eliminate 95% of the emissions.

Wet suppression typically has only a temporary effect on reducing emissions and the control efficiency of wet suppression depends upon local climate conditions, source properties, duration of control effectiveness and frequency of applying wet suppression.

- ***Material Loading and Unloading***

Loading by endloaders, loading in stations, truck/trailer unloading, and railcar unloading are examples of material loading and unloading activities. Material type, material size and characteristic, material moisture content, process throughput, method of loading and unloading, operating practices, and topographical and climatic factors affect the emissions of loading and unloading.

Wet suppression, bottom loading, enclosed operation and vented to add-on control equipment are typical control practice for material loading and unloading activities.

- ***Vehicular Traffic***

Vehicular traffic traveling on roadways between locations at the facilities is a source of particulate emission. Materials adhering to the vehicle tires and rims, the sides, and the bottom of the trucks or trailers fall onto the road, and are subsequently crushed into fine particles, and re-entrained into ambient air. Materials leaking from trucks/trailers, spillage from trucks, and accumulations on roadways are another emission sources.

Control techniques used for unpaved roadways are paving, dust suppression application, route modifications, and soil stabilization. Control techniques for paved roads include utilizing street sweepers and dust suppression. Other control techniques are truck washing to clean outgoing trucks and trailers, truck load covers to reduce spillage and wind entrainment, rumble grates and wheel washers, and good housekeeping practices.

Table C-1 - Emission Sources

Operation	Source of Particulate Matter
<ul style="list-style-type: none"> • Quarry • Crushing • Screening • Blending • Pyroprocessing • Grinding • Milling • Storage 	<ul style="list-style-type: none"> • Material Processing (e.g. Crushing, Milling, Combustion and Pyroprocessing in Kiln and Clinker Cooler) • Material Loading, Unloading and Conveying • Vehicle Traffic (e.g. Front End Loader) • Wind Erosion, Re-entrainment, and Spillage

Table C-2 - Control Techniques

Emission Source	Control Techniques
Kilns/Clinker Coolers	<ul style="list-style-type: none"> • Baghouses
Crushing, Grinding, Screening, Milling, Blending, Drying, and Other Processes	<ul style="list-style-type: none"> • Enclosed and Vented to Baghouses • Wet Suppression
Storage Bins, Hoppers, Tanks, Piles	<ul style="list-style-type: none"> • Enclosed and Vented to Baghouses • Wet Suppression
Loading & Unloading	<ul style="list-style-type: none"> • Enclosed Truck/Railcar Unloading and Vented to Baghouses • Wet Suppression • Techniques to Reduce Freefall Distances (e.g. Transfer Chute)
Conveying System	<ul style="list-style-type: none"> • Enclosed and Vented to Baghouses • Wet Suppression • Techniques to Reduce Freefall Distances (e.g. Stack Conveyor)
Vehicle traffic and Roadways	<ul style="list-style-type: none"> • Conveying System In Lieu of Truck Transporting • Route Modification (e.g. Paving, Adding Gravel/Slag to Dirt Road) • Dust Suppression Application (Water With /Without Surfactants) • Soil Stabilization • Vehicle Restrictions (e.g. Limit Speed, Limit Number of Vehicles) • Prevention and Street Sweeping • Truck Wash • Covers and Leak Resistant Bottoms On Trucks
Wind Erosion	<ul style="list-style-type: none"> • Enclosure and Wet Suppression
Spillage	<ul style="list-style-type: none"> • Good Housekeeping

Table C-3 – Emission Factors

Operations/Emission Sources	Emission Factors	Unit	Reference
LOADING AND UNLOADING @ Quarry, Crushing, Grinding, Screening, Milling, Blending, and Storage Sites	<ul style="list-style-type: none"> TSP: $k_L \times 0.0032 \times \left(\frac{U}{5}\right)^{1.3} \times \left(\frac{M}{2}\right)^{-1.4}$ PM10: 47% TSP 	lb/ton materials	AP-42 (Chapter 13.2.4, Equation 1)
VEHICLE TRAFFIC @ Quarry, Crushing, Grinding, Screening, Milling, Blending, and Storage Sites	<ul style="list-style-type: none"> TSP: $k_E \times \left(\frac{s}{12}\right)^a \times \left(\frac{W}{3}\right)^b \times \left(\frac{365-P}{365}\right)$ PM10: 31% TSP 	lb/vehicle-miles	AP-42 (Chapter 13.2.2, Equation 1a & Equation 2)
WIND EROSION @ Quarry, Crushing, Grinding, Screening, Milling, Blending, and Storage Sites	<ul style="list-style-type: none"> TSP: 0.72 u PM10: 31% TSP 	lb/acre-hr	AP-42 (Chapter 11.9, Table 11.9-1)
BLASTING @ Quarry Site	<ul style="list-style-type: none"> TSP: $1.4 \times 10^{-5} (A)^{1.5}$ PM10: 52% TSP 	lb/blast	AP-42 (Chapter 11.9, Table 11.9-1)
CRUSHING	<ul style="list-style-type: none"> TSP: $2.1 \text{ PM10} = 5.0 \times 10^{-3}$ PM10: 2.4×10^{-3} 	lb/ton materials	AP-42 (Chapter 11.19.2, Table 11.19.2-2)
Crushing (Primary) with Fabric Filter	<ul style="list-style-type: none"> TSP: 1.0×10^{-3} PM10: No Data, ~50% TSP = 5.0×10^{-4} 	lb/ton materials	AP-42 (Chapter 11.6, Table 11.6-4)
Crushing (Tertiary) with Wet Suppression	<ul style="list-style-type: none"> TSP: $2.1 \text{ PM10} = 1.2 \times 10^{-3}$ PM10: 5.9×10^{-4} 	lb/ton materials	AP-42 (Chapter 11.19, Table 11.19.2-2)
Crushing Fines	<ul style="list-style-type: none"> TSP: $2.1 \text{ PM10} = 0.03$ PM10: 0.015 	lb/ton materials	AP-42 (Chapter 11.19.2, Table 11.19.2-2)
Crushing Fines with Wet Suppression	<ul style="list-style-type: none"> TSP: $2.1 \text{ PM10} = 4.0 \times 10^{-3}$ PM10: 2.0×10^{-3} 	lb/ton materials	AP-42 (Chapter 11.19, Table 11.19.2-2)
Conveyor Transfer Point @ Crushing Site	<ul style="list-style-type: none"> TSP: $2.1 \text{ PM10} = 2.9 \times 10^{-3}$ PM10: 1.4×10^{-3} 	lb/ton materials	AP-42 (Chapter 11.19.2, Table 11.19.2-2)
Conveyor Transfer Point @ Crushing Site with Wet Suppression	<ul style="list-style-type: none"> TSP: $2.1 \text{ PM10} = 1.0 \times 10^{-4}$ PM10: 4.8×10^{-5} 	lb/ton materials	AP-42 (Chapter 11.19.2, Table 11.19.2-2)
Conveyor Transfer Point @ Crushing Site with Fabric Filter	<ul style="list-style-type: none"> TSP: 2.9×10^{-5} PM10: No Data, ~0.5 TSP = 1.5×10^{-5} 	lb/ton materials	AP-42 (Chapter 11.6, Table 11.6-4)

Operations/Emission Sources	Emission Factors	Unit	Reference
SCREENING			
	<ul style="list-style-type: none"> TSP: 2.1 PM10 = 0.03 PM10: 0.015 	lb/ton materials	AP-4 (Chapter 11.19.2, Table 11.19.2-2)
Screening with Wet Suppression	<ul style="list-style-type: none"> TSP: 2.1 PM10 = 1.8×10^{-3} PM10: 8.4×10^{-4} 	lb/ton materials	AP-4 (Chapter 11.19.2, Table 11.19.2-2)
Screening with Fabric Filter	<ul style="list-style-type: none"> TSP: 2.2×10^{-4} PM10: No Data, $\sim 0.5 \text{ TSP} = 1.1 \times 10^{-4}$ 	lb/ton materials	AP-4 (Chapter 11.6, Table 11.6-4)
Screening Fines	<ul style="list-style-type: none"> TSP: 2.1 PM10 = 0.15 PM10: 0.07 	lb/ton materials	AP-4 (Chapter 11.19.2, Table 11.19.2-2)
Screening Fines with Wet Suppression	<ul style="list-style-type: none"> TSP: 2.1 PM10 = 4.4×10^{-3} PM10: 2.1×10^{-3} 	lb/ton materials	AP-42 (Chapter 11.19.2, Table 11.19.2-2)
RAW MATERIAL MILLING			
Raw Mill with Fabric Filter	<ul style="list-style-type: none"> TSP: 0.012 PM10: No Data, $\sim 0.5 \text{ TSP} = 6.0 \times 10^{-3}$ 	lb/ton materials	AP-42 (Chapter 11.6, Table 11.6-4)
Raw Mill Feed Belt with Fabric Filter	<ul style="list-style-type: none"> TSP: 3.1×10^{-3} PM10: No Data, $\sim 0.5 \text{ TSP} = 1.6 \times 10^{-3}$ 	lb/ton materials	AP-42 (Chapter 11.6, Table 11.6-4)
Raw Mill Weight Hopper with Fabric Filter	<ul style="list-style-type: none"> TSP: 0.02 PM10: No Data, $\sim 0.5 \text{ TSP} = 0.01$ 	lb/ton materials	AP-42 (Chapter 11.6, Table 11.6-4)
Raw Mill Air Separator with Fabric Filter	<ul style="list-style-type: none"> TSP: 0.032 PM10: No Data, $\sim 0.5 \text{ TSP} = 0.016$ 	lb/ton materials	AP-42 (Chapter 11.6, Table 11.6-4)
PRODUCT MILLING			
Finish Mill with Fabric Filter	<ul style="list-style-type: none"> TSP: 8.0×10^{-3} PM10: No Data, $\sim 0.5 \text{ TSP} = 4.0 \times 10^{-3}$ 	lb/ton materials	AP-42 (Chapter 11.6, Table 11.6-4)
Finish Mill Feed Belt with Fabric Filter	<ul style="list-style-type: none"> TSP: 2.4×10^{-3} PM10: No Data, $\sim 0.5 \text{ TSP} = 1.2 \times 10^{-3}$ 	lb/ton materials	AP-42 (Chapter 11.6, Table 11.6-4)
Finish Mill Weight Hopper with Fabric Filter	<ul style="list-style-type: none"> TSP: 9.4×10^{-3} PM10: No Data, $\sim 0.5 \text{ TSP} = 4.7 \times 10^{-3}$ 	lb/ton materials	AP-42 (Chapter 11.6, Table 11.6-4)
Finish Mill Air Separator with Fabric Filter	<ul style="list-style-type: none"> TSP: 0.028 PM10: No Data, $\sim 0.5 \text{ TSP} = 0.014$ 	lb/ton materials	AP-42 (Chapter 11.6, Table 11.6-4)

Emission Inventory and Emission Reductions

Table C-4 to Table C-9 presents staff preliminary estimates on emission inventory and emission reductions for California Portland Cement Company and Riverside Cement Company. Table C-4 to Table C-9 (50 pages) are not included in the Preliminary Draft Staff Report, and will be distributed to California Portland Cement and Riverside Cement separately.

Attachment D - Source Test Methods for PM and PM₁₀

AQMD Source Test Method 5.1, 5.2 and 5.3

These AQMD Source Test Methods are used to measure particulate matter emissions from stationary sources. A typical "front-half" sampling train of AQMD Source Test Method 5 includes a probe and a glass filter located outside of the stack. A typical "back-half" sampling train of AQMD Source Test Method 5 includes four glass impingers immersed in an ice bath. The first and second impinger contained deionized, distilled water; the third impinger is left empty; and the fourth impinger is filled with silica gel.

Stack gas sample is withdrawn isokinetically. Temperature of the front-half probe and filter is maintained at 180 ± 20 °F in order to collect all liquid sulfuric acid present in the sample gas. The probe and filter temperature can be maintained at 248 ± 25 °F when testing is performed to show compliance with federal New Source Performance Standards. After the source test, the probe and filter are analyzed for total residue weight, acid content and sulfate content. The probe and filter are not analyzed for organic content because organic compounds do not normally deposit on heated train components.

Condensable particulate matter is defined as materials condensed at standard conditions. To collect all condensable particulate matter, the impingers of the back-half sampling train are immersed in an ice bath to reduce the sampled gas temperature to approximately 60 °F. After the source test, the impinger solution is analyzed for organic content. The impinger solution is then titrated with sodium hydroxide (NaOH) to determine the amount of acid present. Barium chloride (BaCl₂) is then added to the impinger solution to precipitate the sulfate. After all the barium sulfate has been precipitated, the impinger solution is then taken to dryness and the residues weighed. The amount of acid and sulfate found are corrected to and reported as sulfuric acid dihydrate (H₂SO₄·2H₂O). Most of the condensable particulate matter are collected in the solution of the first impinger. While sulfate is considered as solid particulate, organic compounds and sulfuric acid are considered as liquid particulates at standard conditions.

Total particulate mass is defined in AQMD Source Test Method 5 as the sum of the mass collected from both the front-half and back-half of the sampling train. Even though all of the sulfur dioxide exists in the flue gas may not immediately form sulfuric acid in the stack, dissolved sulfur dioxide in the sample gas has a high tendency to form sulfuric acid in the abundant presence of water in the impinger solution. To discount the contribution of particulate matter formed from the dissolved sulfur dioxide, the amount of sulfuric acid found in the impinger solution, which is usually referred to as "acidic" sulfate, is subtracted out from the total particulate mass.

As shown in Figure C-1, a combination of AQMD Method 5 and EPA Method 201A is needed to determine the PM₁₀ emissions from the stack. EPA Method 201A provides an in-stack cyclone that separates the particulates smaller than 10 microns from the particulates larger than 10 microns.

(Reference: AQMD, 1989)

AQMD Source Test Methods for Opacity, Stabilized Surface, Threshold Friction Velocity, Silt Loading and Silt Content

These source tests are described in details in the AQMD Rule 403 Implementation Handbook. The opacity test method can only be conducted by an individual who is certified by the California Air Resources Board (CARB) as a certified Visible Emission Evaluation (VEE) observer. The purpose of the stabilized surface test method is to check whether a property is sufficiently crusted to prevent windblown dust. The purpose of the threshold friction velocity test is to determine a site susceptibility to wind driven soil erosion. The silt loading and silt content test is used to determine the silt loading and content of a road; the higher the silt content, the more dust particles can be released when vehicles passing on a specific roadway.

(Reference: AQMD, 2004)

EPA Source Test Method 5 and 5D

EPA Source Test Method 5 is often used for the determination of PM mass emissions. It is similar to AQMD Source Test Method 5 except the temperature of the filter is maintained in the range of 120 ± 14 degree C.

EPA Source Test Method 5D describes a sampling technique to measure PM mass emissions from positive pressure fabric filters. This method was used at Riverside Cement to measure the PM mass emissions from their kilns and clinker coolers.

(Reference: EPA, 1998)

EPA Source Test Method 201A

EPA Source Test Method 201A, "Determination of PM₁₀ Emissions (Constant Sampling Rate Procedures)", is used to measure in-stack PM₁₀ emissions. In EPA Source Test Method 201A, an in-stack cyclone, or a cascade impactor, is used to separate particles larger than 10 microns from particles less than or equal to 10 microns; and an in-stack glass fiber filter is used to collect the PM₁₀. Stack gas sample is extracted at a constant flow rate. The particulate mass collected with the sampling train is then determined gravimetrically after removal the uncombined water.

(Reference: EPA, 1998)

EPA Source Test Method 202

EPA Source Test Method 202, "Determination of Condensible Particulate Emissions from Stationary Sources" is the source test method officially approved by EPA to measure condensible particulate matter. EPA Source Test Method 202 is used concurrently with other EPA source test method such EPA Method 201A for measuring

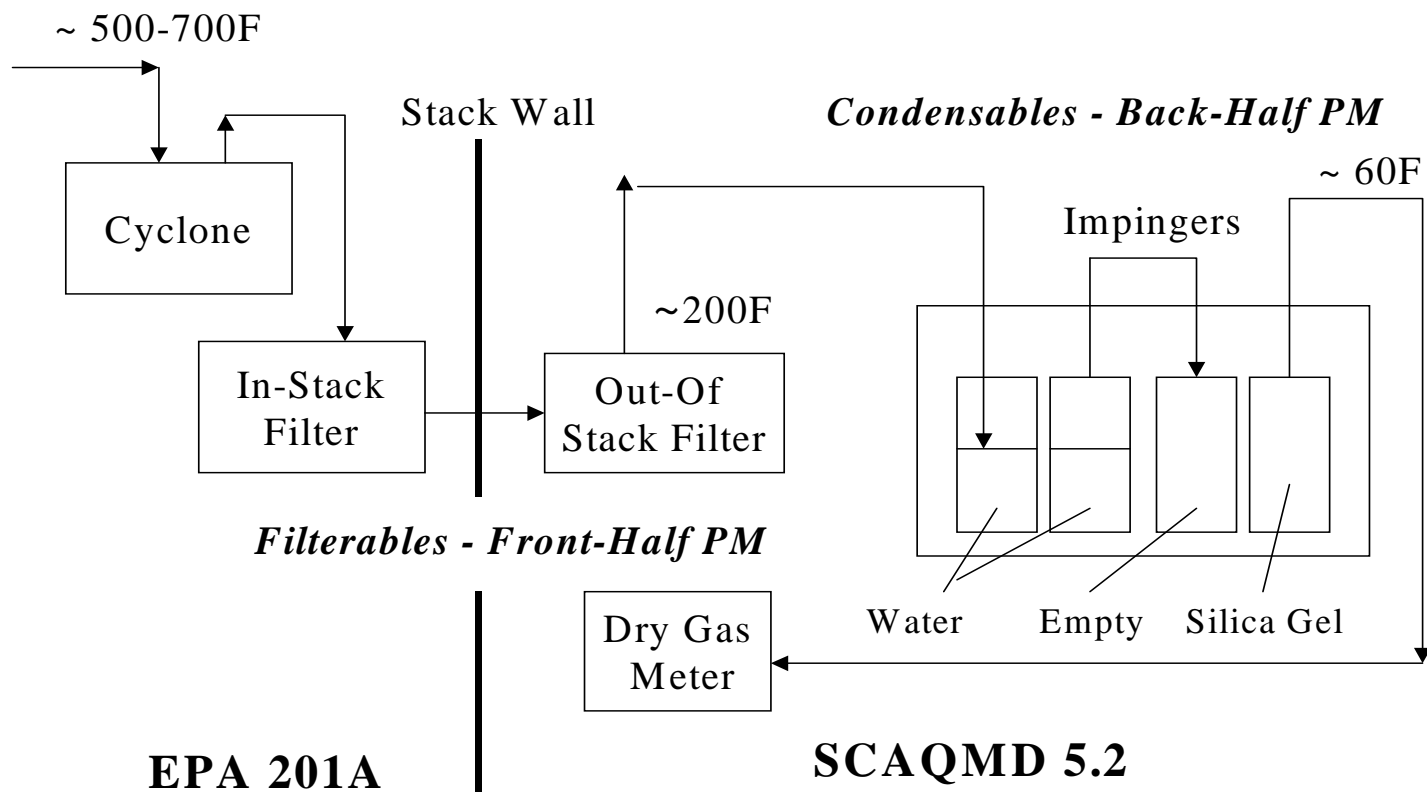
the filterable particulate matter or "front-half" particulate matter. The impinger train includes three impingers containing water following by one impinger containing silica gel. The impingers are immediately purged after the run with nitrogen to remove dissolved SO₂ from the impinger contents. Purging is not effective with ammonia. The impinger solution is then extracted with methylene chloride (MeCl₂). The organic and aqueous fractions are then taken to dryness and the residue weighed. The total of both fractions represents the condensible particulate matter or "back-half" particulate matter.

(Reference: EPA, 1998)

EPA Proposed Source Test Method To Quantify Capture Efficiency

As documented in the recent 1994 EPA source tests, EPA staff that participated in the source testing had noticed that the capture efficiency of a control device could vary from 60% to 99% by visual observation. Since the overall control efficiency of a control device is a product of capture efficiency and collecting efficiency, it is important to have a reliable source test method that can quantify as accurate as possible the capture efficiency of a control device. In a most recent 2003 source test protocol for EPA at a truck loading and central mix operation facility, a contract source testing team has proposed to use a Tapered Electrode Oscillating Microbalance (TEOM) device meeting EPA ambient particulate matter monitoring requirements to measure the PM10 ambient concentration downwind of the central mix operation. In parallel, the contract source testing team will set up a downwind sampling array mounted vertically on the side wall of a truck loading area and at the inlet of central mixing operations to measure the fugitive dust mass flux through a defined area. The fugitive (uncaptured) PM10 emissions will then be determined by multiplying the measured ambient PM10 concentration measured by the TEOM device by the ambient air flow rate through the sampling array. The data from the TEOM will be compared with the PM10 data measured at the inlet to the fabric filter to quantify the capture efficiency of the plant hood system. In addition, EPA Method 22 visual observations will be also conducted during the run to confirm that fugitive emissions from the mixer loading areas are passing through the sampling array.

(Reference: EPA, 1998 and EPA, 2003)

Figure D-1**Sampling Train of a Combination of EPA Method 201A and AQMD Method 5.2**

Attachment E - Test Results for Kilns and Clinker Coolers

Table E-1 contains source test results for sampling conducted at California Portland Cement Company and Riverside Cement Company from 1990 to 1999.

- California Portland Cement Company operates two parallel kilns and clinker coolers with one baghouse for each kiln and one baghouse for each clinker cooler.

The average emission rates of the ten source tests for kilns and the eight source tests for clinker coolers show the following emission rates:

- 0.26 lb/ton clinker, for kilns
- 0.07 lb/ton clinker, for clinker coolers
- 0.01 grain/dscf for both kilns and clinker coolers

In 1999, there were two tests conducted at California Portland Cement Company kiln #1 using EPA Method 201A/202 for PM₁₀, and using AQMD Method 5.2 for PM. The information in these source tests show the following emission rates:

- 0.28 lb PM/ton clinker and 0.14 lb PM₁₀/ton clinker, for kilns burning coal only;
- 0.29 lb PM/ton clinker and 0.21 lb PM₁₀/ton clinker, for kilns burning coal and tires;
- A fraction of PM₁₀ in the total PM is 0.5 for kilns burning coal, and almost 0.9 for kilns burning coal and tires.

- Riverside Cement Company operates two parallel kilns and clinker coolers vented to two open top baghouses. The average emission rates of the ten source tests for kilns and the eight source tests for clinker coolers show the following emission rates:

- 0.55 lb/ton clinker
- 0.02 grain/dscf for kilns and clinker coolers

- Based on the above source test data, the following shall be used for emission inventory:
 - 0.3 lb/ton clinker for kilns, and 0.07 lb/ton clinker for clinker coolers for CPCC
 - 0.55 lb/ton clinker for kilns/clinker coolers at Riverside Cement Company, and
 - A fraction of 0.5 PM₁₀/PM is used to determine PM₁₀ inventory from PM inventory.

Table E-1 - Summary of Source Test Results at CPCC

Test Report No		PR-97053	PR-97053	96-CST-057A	96-CST-057A	95-0015	95-0015
Test Date		6/99 - 7/99	6/99 - 7/99	Mar-97	Mar-97	Jan-95	Jan-95
Testing Firm		Delta Air Quality Services	Delta Air Quality Services	Horizon	Horizon	AQMD Staff	AQMD Staff
		Kiln #1	Kiln #1	Kiln #2	Clinker Cooler #2	Kiln #1	Clinker Cooler #1
		Coal	Coal with Tires				
Test Method PM10		EPA 201A/202	EPA 201A/202				
Test Method PM		AQMD 5.2	AQMD 5.2	AQMD 5.2	AQMD 5.2	AQMD 5.3	AQMD 5.3
Kiln Feed Avg	tons/hr	43.17	38.57	73.3	73.3	66.5	66.5
Coal Feed Avg	tons/hr	7.9	6.85				
Tire Feed Avg	tons/hr	0	11-12% total fuel				
Clinker Output	tons/hr	not measured	not measured	47.7	47.7	41.6	41.6
Ratio Clinker/Feed	tons/ton			0.65	0.65	0.63	0.63
Stack Gas Flow Rate - Outlet	dscfm	122,766 - 130,129	125,387 - 128,853	132,034	41,119	122,800	50,030
Stack Temperature	F	350 F	350 F	345	187	313	166
% O2 Kiln Exit	%	1.29	2.03				
% O2 Baghouse Exit	%	13.87	14.43	14.1	20.9	13.9	12.6
Stack NOx	ppm	166 - 232	100 - 122			303	-
Stack CO	ppm	63 - 76	93 - 240	45.3		527	-
Front-half PM	gr/dscf	0.0065	0.0052	0.0032	0.0016	0.0027	0.0039
Front-half PM	lb/hr	6.8	5.53	3.64	0.58	2.88	1.68
Back-half PM	gr/dscf	0.0005	0.0023	0.0022	0.0015	0.0236	0.00276
Back-half PM	lb/hr	0.55	2.48	2.49	0.52	24.841	1.18
Total PM (Front + Back)	gr/dscf	0.007	0.0075	0.0054	0.0031	0.0263	0.00676
Total PM (Front + Back)	lb/hr	7.35	8.01	6.13	1.10	27.73	2.86
Total PM10 (Front + Back)	gr/dscf	0.0033	0.0053				
Total PM10 (Front + Back)	lb/hr	3.68	5.82				
Ratio PM10/PM		0.50	0.73				
Total PM	lb/ton feed	0.17	0.21	0.08	0.02	0.42	0.04
Total PM10	lb/ton feed	0.09	0.15				
Total PM (if clinker was not measured, a factor of 0.6 ton clinker/ton feed is used for estimation)	lb/ton clinker	0.28	0.35	0.13	0.02	0.67	0.07

Table E-1 - Summary of Source Test Results at CPCC (Continue)

Test Report No		95-CST-127	95-CST-127	95-CST-121	95-CST-121	94-CST-113	94-CST-113
Test Date		Jan-96	Jan-96	Nov-95	Nov-95	Feb-95	Feb-95
Testing Firm		TEAM Env Services	TEAM Env Services	TEAM Env Services	TEAM Env Services	Petro Chem Env Services	Petro Chem Env Services
		Kiln #1	Clinker Cooler #1	Kiln #1	Clinker Cooler #1	Kiln #2	Clinker Cooler #2
Test Method PM10							
Test Method PM		AQMD 5.1	AQMD 5.1	AQMD 5.1	AQMD 5.1	AQMD 5.1	AQMD 5.1
Kiln Feed Avg	tons/hr	42.69	42.69	44.5	44.5	75	75
Coal Feed Avg	tons/hr						
Tire Feed Avg	tons/hr						
Clinker Output	tons/hr	not measured	not measured	not measured	not measured	40.85	40.85
Ratio Clinker/Feed	tons/ton					0.54	0.54
Stack Gas Flow Rate - Outlet	dscfm	129,332	44,071	132,200	44,345	143,228	47,384
Stack Temperature	F	316	178	363	160	306	237
% O2 Kiln Exit	%						
% O2 Baghouse Exit	%	14.48	20.9	16.41	20.9	9.96	20.9
Stack NOx	ppm					303	-
Stack CO	ppm	28.32		36.96		29	-
Front-half PM	gr/dscf	0.00103	0.00027	0	0.00018	0.00007	0.00046
Front-half PM	lb/hr	1.14	0.102	0	0.07	0.086	0.188
Back-half PM	gr/dscf	0.0072	0.0034	0.01105	0.0023	0.004	0.017
Back-half PM	lb/hr	7.94	1.27	12.5	0.86	4.78	6.99
Total PM (Front + Back)	gr/dscf	0.0082	0.0039	0.011	0.0026	0.0047	0.019
Total PM (Front + Back)	lb/hr	9.05	1.40	12.50	0.93	4.9	7.2
Total PM10 (Front + Back)	gr/dscf						
Total PM10 (Front + Back)	lb/hr						
Ratio PM10/PM							
Total PM	lb/ton feed	0.21	0.03	0.28	0.02	0.07	0.10
Total PM10	lb/ton feed						
Total PM (if clinker was not measured, a factor of 0.6 ton clinker/ton feed is used for estimation)	lb/ton clinker	0.35	0.05	0.47	0.03	0.11	0.16

Table E-1 - Summary of Source Test Results at CPCC (Continue)

Test Report No		93-CST-176	93-CST-176	91-CST-387	91-CST-387	90-CST-218	90-CST-218	AVG KILN (10 TESTS)	AVG COOLER (8 TESTS)
Test Date		Nov-93	Nov-93	Jan-93	Jan-93	Sep-91	Sep-91		
Testing Firm		Team Env Services	Team Env Services	Team Env Services	Team Env Services	Tracer Technologies	Tracer Technologies		
		Kiln #1	Clinker Cooler #1	Kiln #1	Clinker Cooler #1	Kiln #1	Clinker Cooler #1		
Test Method PM10									
Test Method PM		AQMD 5.1	AQMD 5.1	AQMD 5.1	AQMD 5.1	AQMD 5.1	AQMD 5.1		
Kiln Feed Avg	tons/hr	79	79	75	75	75	75		
Coal Feed Avg	tons/hr								
Tire Feed Avg	tons/hr								
Clinker Output	tons/hr	51.3	51.3	47	47	46.6	46.6		
Ratio Clinker/Feed	tons/ton	0.65	0.65	0.63	0.63	0.62	0.62		
Stack Gas Flow Rate - Outlet	dscfm	137,240	44,637	133,198	58,706	100,240	38,027		
Stack Temperature	F	344	164	339	169	294	132		
% O2 Kiln Exit	%								
% O2 Baghouse Exit	%	14.4	20.9	17	20.9	18.7	20.9		
Stack NOx	ppm			286		395			
Stack CO	ppm			38		100			
Front-half PM	gr/dscf	0	0	0.00081	0	0.000118	0.000116		
Front-half PM	lb/hr	0	0	0.924	0	0.102	0.038		
Back-half PM	gr/dscf	0.0063	0.0034	0.00291	0.017	0.00459	0.00356		
Back-half PM	lb/hr	7.15	1.3	3.32	8.57	3.94	1.16		
Total PM (Front + Back)	gr/dscf	0.0063	0.0034	0.004	0.017	0.0047	0.0037	0.01	0.01
Total PM (Front + Back)	lb/hr	7.15	1.3	4.24	8.57	4.04	1.2	9.11	3.07
Total PM10 (Front + Back)	gr/dscf								
Total PM10 (Front + Back)	lb/hr								
Ratio PM10/PM									
Total PM	lb/ton feed	0.09	0.02	0.06	0.11	0.05	0.02	0.16	0.04
Total PM10	lb/ton feed								
Total PM (if clinker was not measured, a factor of 0.6 ton clinker/ton feed is used for estimation)	lb/ton clinker	0.14	0.03	0.09	0.18	0.09	0.03	0.27	0.07

Table E-2 - Summary of Source Test Results for Riverside Cement

Test Report		93-CST-213	93-CST-214	89-CST-149	91-CST-398	90-CST-320	90-CST-319	AVG KILN (6 TESTS)
Test Date		Nov-94	Mar-94	Jan-91	Mar-93	Dec-91	Dec-91	
Testing Firm		Almega	Almega	Energy and Environm Research Corporation	Team Environmental Services	Tracer Technologies	Tracer Technologies	
		Kiln #1	Kiln #2	Kiln #1	Kiln #1	Kiln #2	Kiln #1	
Test Method PM		EPA Method 5D	EPA Method 5D	AQMD Method 5.3 (similar to EPA Method 17)	EPA Method 5D & AQMD Method 5.3	EPA Method 5D & AQMD Method 5.3	EPA Method 5D & AQMD Method 5.3	
Fuel Type		Oil	Oil	No 6 Oil				
Kiln Feed Avg	tons/hr	7.22	7.57	18.3	16.5	20	20	
Clinker Output	tons/hr	4.19	4.39	Not measured	6.57	8	8	
Maximum Clinker Output	tons/hr	30	30	30				
Ratio Clinker/Feed		0.58	0.58		0.40	0.40	0.40	
Baghouse Inlet Gas Flow Rate	dscfm	39,396	41,801	58,502	40,488	38,892	36,989	
Baghouse Outlet Gas Flow Rate	dscfm	18,003	17,338	20,100	33,084	24,198	24,030	
% Oxygen Inlet Flue Gas	%	12	12.5	10.7	16.6	10.1	9.8	
Inlet Flue gas temperature	F	564	655	547	537	541	510	
Baghouse Stack Temperature	F	221	322	322	306	304	243	
Total PM (Solid for R.405)	lb/hr	1.91	1.77	7.14	1.37	6.18	5.29	
Total PM (Front + Back)	lb/hr	2.09	1.93	7.35	1.56	6.18	5.30	
Total PM (For R.404)	gr/dscf	0.0135	0.013	0.0428	0.0055	0.0297	0.0258	0.02
Limit Rule 404(a)		0.0633	0.0642	0.061	0.05	0.0568	0.057	
Total PM (Front + Back)	lb/ton feed	0.29	0.26	0.40	0.09	0.31	0.26	0.27
Total PM (Front + Back) (factor of 0.6 clinker/feed is used if clinker was not measured)	lb/ton clinker	0.50	0.44	0.67	0.24	0.77	0.66	0.55

Attachment F – Test Results for AP-42 Emission Factors

In order to develop emission factors for the operations and associated equipment at the cement manufacturing, U.S. EPA has collected information on source testing at various cement manufacturing facilities throughout the U.S. All of the equipment (e.g. crushers, screens, raw mills, finish mills) at these cement manufacturing facilities is vented to baghouses. Source tests were conducted following EPA Method 5 or EPA Method 201A. The following data were measured and recorded during the source tests:

- PM or PM10 emission rates (grain/dscf) at the outlet of the baghouses;
- Amount of materials processed or transferred during the tests (tons); and
- Flue gas flow rates (dscf).

Using the information above, U.S. EPA developed an average emission factor for each equipment, in term of lbs/tons of materials processed or transferred, These average emission factors are documented in AP-42, Chapter 11.6 and 11.12.

In Table F-1, staff has summarized the following information:

- Average emission factor (lbs/ton) documented in AP-42 Chapter 11.6 and 11.12;
- Emission factor (lbs/ton) determined in each individual source test;
- Outlet concentration (grain/dscf) measured at the outlet of the baghouse in each individual test;
- Source test method used in each individual test; and
- Other miscellaneous but relevant information such as opacity measured during each individual test, capture efficiency and collecting efficiency of the baghouse.

The information in Table F-1 demonstrates the following:

- AP-42 emission factors represent the “best” or “near best” situation that could occur, e.g. no visible emissions, baghouse was usually operated at optimum conditions during the tests;
- A level of 0.005 gr/dscf or less at the outlet of the baghouse was achieved through many of these source tests;
- The capture efficiency of a baghouse can be as low as 30% - 50% in some tests; and
- The PM10/PM factor can be as high as 80% - 90% in cement and fly ash loading and unloading operations.

Table F-1 - Summary of Source Test Results Underlying EPA AP-42 Emission Factors

	Average AP-42 PM Emission Factor (lb/ton)	Reference for Source Tests	Emission Factor from Source Tests (lb/ton)	Baghouse Outlet (grain/dscf)	Source Test Method
Kiln		4	0.03 lb/ ton clinker	0.002	EPA Method 5 - Filterable
		5	0.07 lb/ton clinker	0.005	EPA Method 5 - Filterable
Raw mill with baghouse	0.012	1, 4	0.009	0.0035	EPA Method 5 - Filterable
		1, 5	0.011	0.005	EPA Method 5 - Filterable
Raw mill feed belt with baghouse	0.0031	1, 5	0.0031	0.0025	EPA Method 5 - Filterable
Raw mill weigh hopper with baghouse	0.019	1, 3	0.019	0.015	Described in report for filterable.
		1, 3	0.022	0.016	Described in report for filterable and condensable
Raw mill air separator with baghouse	0.032	1, 3	0.032	0.024	Described in report for filterable.
		1, 3	0.035	0.026	Described in report for filterable and condensable
Finish mill with baghouse	0.008	1, 4	0.005	0.0039	EPA Method 5
		1, 5	0.004	0.0024	EPA Method 5
Finish mill feed belt with baghouse	0.0024	1, 5	0.0024	0.0057	EPA Method 5 - Filterable
Finish mill weigh hopper with baghouse	0.0094	1, 3	0.0094	0.003	Described in report for filterable.
		1, 3	0.0156	0.005	Described in report for filterable and condensable
Finish mill air separator with baghouse	0.028	1, 3	0.017	0.0046	Described in report for filterable
		1, 3	0.032	0.0087	Described in report for filterable and condensable

	Average AP-42 PM Emission Factor (lb/ton)	Reference for Source Tests	Emission Factor from Source Tests (lb/ton)	Baghouse Outlet (grain/dscf)	Source Test Method	Baghouse and Capture Efficiency
Primary limestone crushing with baghouse	0.001	1, 6	0.001	0.005	EPA Method 5 - Filterable	99.9 % efficiency. No visible emissions during testing. Inlet and outlet of crusher were both vented to baghouse
		1, 6	0.0012	-	EPA Method 5 - Filterable & Condensable	99.9 % efficiency. No visible emissions during testing
Primary limestone screening with baghouse	0.00022	1, 6	0.00022	0.0018	EPA Method 5 - Filterable	99.9 % efficiency. No visible emissions during testing
		1, 6	0.0003	-	EPA Method 5 - Filterable & Condensable	99.9 % efficiency. No visible emissions during testing
Limestone transfer with baghouse	0.000029	1, 6	0.000029	0.0016	EPA Method 5 - Filterable	99.9 % efficiency. No visible emissions during testing
		1, 6	0.000036	-	EPA Method 5 - Filterable & Condensable	99.9 % efficiency. No visible emissions during testing
Secondary limestone crushing and screening with baghouse	0.00031	1, 6	0.00031	0.0006	EPA Method 5 - Filterable	99.9 % efficiency. No visible emissions during testing
		1, 6	0.0004	-	EPA Method 5 - Filterable & Condensable	99.9 % efficiency. No visible emissions during testing
Cement unloading to elevated storage silo (pneumatic)	0.00099	2, 7	-	0.0003 (PM); 0.0002 (PM10)	EPA Method 5 for PM Filterable. EPA Method 201A for PM10 Filterable	Capture efficiency from 50% to 90%. Baghouse efficiency 99.9%.
		2, 8	0.0008 (PM); 0.0007 (PM10)	0.006 (PM); 0.005 (PM10)	EPA Method 5 for PM Filterable. EPA Method 201A for PM10 Filterable	Capture efficiency from 50% to 90%. Baghouse efficiency 99.9%.
Fly ash unloading to elevated storage silo (pneumatic)	0.0089	2, 8	0.0062 (PM); 0.0056 (PM10)	0.052 (PM); 0.048 (PM10)	EPA Method 5 for PM Filterable. EPA Method 201A for PM10 Filterable	Capture efficiency from 30% to 80%. Baghouse efficiency 99.9%.

Note:

1. AP-42, Chapter 11.6, Table 11.6-4, January 1995 Version
2. AP-42, Chapter 11.12, Table 11.12-2, October 2001 Version
3. Emissions From Dry Process Raw Mill And Finish Mill System At Ideal Cement Company, New Mexico, ETB Test No 71-MM-02, U.S. EPA, Research Triangle Park, NC, April 1972
4. Performance Guarantee Testing At Southwestern Portland Cement, Pape & Steiner Environmental Services, Bakersfield, CA, February 1985
5. Compliance Testing At Southwestern Portland Cement, Pape & Steiner Environmental Services, Bakersfield, CA, February 1985
6. Part I, Air Pollution Emission Test: Arizona Portland Cement, EPA Project No. 74-STN-1, U.S. EPA, Research Triangle Park, NC, June 1974
7. Final Test Report for U.S. EPA, Test Program Conducted At Chaney Enterprises Cement Plant, Maryland, ETS, Inc., Roanoke, VA, April 1994
8. Final Test Report for U.S. EPA, Test Program Conducted At Concrete Ready Mixed Corporation, ETS, Inc., Roanoke, VA, April 1994

Attachment G - Survey Questionnaires

On March 2004, staff developed the following questionnaires and visited California Portland Cement and Riverside Cement to collect the information for determining emission inventory and current status of control at the two facilities. Staff received most of the information in July 2004, however staff will request additional information to complete the analysis of emission inventory and cost of compliance with future requirements of PR 1156. Following are the questions asked in the Survey Interview. Staff has used the information provided to estimate a preliminary emission inventory & reductions, and to conduct a preliminary cost effectiveness analysis.

SURVEY INTERVIEW

Proposed Rule 1156 - Further Reductions of PM10 Emissions from Cement Manufacturing Operations

Facility Contact

- 1) Please provide the facility contact for this project.

Contact's Name: _____

Title: _____

Phone Number: _____

E-mail Address: _____

Facility Information

- 2) Please provide a facility plot plan and general flow diagrams of all operations related to cement manufacturing (i.e. from quarry, rock storage, raw grinding operations to kiln, finish grinding, storage, and shipping operations) at your facility.
- 3) Please provide the following information on the current production of the facility, and please indicate if information is confidential.
- Types of products produced at your facility. If available, please provide Material Safety Data Sheet (MSDS) for each product.
 - Maximum and average yearly production rate of each type of products.
 - Methods of delivering and transport each product to your customers (e.g. # of trucks, rail cars), and maximum and average delivering and transporting rate of each product.
- 4) Please provide the following information on the raw materials used in the production
- Types of raw materials used at your facility. If available, please provide MSDS for each material.
 - Methods of receiving each raw material, and maximum and average yearly receiving rate of each material

Process and Equipment Information

- 5) Please identify all source(s)/equipment that potentially generate PM and PM10 emissions at your facility. For each source:
- Please provide equipment/process information (use **Attachment 1**). Please indicate if it is permitted or non-permitted equipment. If the source is a permitted equipment, please provide information that can be used to identify this equipment in the facility permit (e.g. device, process and system identification number)
 - If a control method/technique is currently employed to reduce particulate emissions, please provide information related to the current design, monitoring, maintenance and installation/operating costs of the control device (use **Attachment 2**).

Emissions Information

- 6) For each source:
- Indicate whether the emissions are reported via the Annual Emissions Reporting Program. Did you include emissions estimation for paved roads, unpaved roads, storage piles and transport processes in your Annual Emissions Report?
 - Provide the estimated annual emissions of PM and PM10 (use **Attachment 1**). For the cement kilns, in addition to PM and PM10, please provide information on NOx and SOx.
 - Describe the method of estimation PM and PM10 emissions (e.g. based on source test results, generic EPA AP-42 emission factors, or other protocols), provide all assumptions used in the emission estimation, and documents to support the approach used;
 - Provide the overall facility emissions of PM, PM10, SOx, and NOx for the 2001-2002 and 2002-2003 reporting years in tons per year.

Existing Rules/Regulations

- 7) For each source, please identify all applicable federal, state, and AQMD environmental regulations (e.g. 40 CFR Part 60, Subpart F, 40 CFR Part 63 Subpart LLL, AQMD Rule 401, 403, 404, 405, 1112.1 e.t.c.).
- 8) Please briefly describe other agency regulations that may be related to air quality (e.g. OSHA regulations applicable for enclosed spaces).
- 9) Do you operate under a construction or related local permit? If yes, please provide a copy.

Source Testing Information

- 10) For each source that you have source test data available, please provide copies of the most recent test reports within the last 5 years and the following information:
- Reason for testing (e.g. rule requirement, annual emission fee determination, information purpose) and frequency of testing
 - If testing is required by any Federal, State or District regulation, please cite the regulation

Breakdowns and Upsets

- 11) Please provide the following information on breakdowns and upsets of any operations at your facility resulted in PM and PM10 emissions within the last 5 years.
- Number of breakdowns and upsets _____
 - Brief description of each occurrence, duration of each occurrence, and estimated PM and PM10 emissions for each occurrence, and remedial actions

Violations and Complaints

- 12) Please provide the following information on violations and complaints related to PM or PM10 emissions at any operations at your facility within the last 5 years.
- Number of violations and complaints by agency _____
 - Brief description of each occurrence, duration of each occurrence, and estimated PM and PM10 emissions for each occurrence that resulted in a violation or a complaint and remedial actions

Attachment 1

Process Information

Please provide information listed below, and include other pertinent information to refine the PM and PM10 emissions determination and inventory for cement manufacturing operations at your facility.

Quarry operations

- Blasting frequency _____
- Number of trucks involved in the loading of quarry _____
- Maximum and average loading rate _____
- General description of current control method/technology for PM and PM10 at these operations and its effectiveness
- General description of current monitoring for PM and PM10
- Operating schedule _____
- Estimated emissions _____
- AER Reported (Yes/No) _____

Crushing and screening operations

- Capacity of primary crushers _____
- Capacity of secondary crushers _____
- Maximum and average rate of crushing and screening _____
- Maximum and average unloading rate of each raw material _____
- Identify open, closed, or semi-closed conveyors between transfer points, provide length and other dimensions. Use drawing if possible.
- General description of current control method/technology for PM and PM10 at these operations and its effectiveness
- General description of current monitoring for PM and PM10
- Operating schedule: _____
- Estimated emissions _____
- AER Reported (Yes/No) _____

Milling and blending operations (raw materials and products)

- Maximum and average rate of milling and blending _____
- General description of current control method/technology for PM and PM10 at these operations and its effectiveness
- General description of current monitoring for PM and PM10
- Operating schedule: _____
- Estimated emissions _____
- AER Reported (Yes/No) _____

Solid materials storage (raw materials and products silos)

- Materials stored in silos or open storage piles _____
- Dimensions of open storage piles _____
- Moisture content _____
- Silt content _____
- Loading and unloading activities and rate _____
- Number of disturbances per year _____
- General description of current control method/technology for PM and PM10 at these operations and its effectiveness
- General description of current monitoring for PM and PM10
- Operating schedule: _____
- Estimated emissions _____
- AER Reported (Yes/No) _____

Product loading/unloading operations

- Loading and unloading rate _____
- Loading and unloading frequency _____
- Number of trucks, rail cars, or other transportation methods involving in the loading/unloading operations per day.
Amount of fuel consumption.
 - Trucks _____
 - Rail cars _____
 - Others _____
- General description of current control method/technology for PM and PM10 at these operations and its effectiveness
- General description of current monitoring for PM and PM10
- Operating schedule: _____
- Estimated emissions _____
- AER Reported (Yes/No) _____

Cement kilns and clinker coolers

- Type of raw materials used, maximum and average feed rate

Materials	Max Feed Rate (or Production Rate)	Avg Feed Rate (or Production Rate)
_____	_____	_____
_____	_____	_____
_____	_____	_____

- Type of fuel used, maximum and average rate of fuel burned. Except for natural gas, please attach fuel analysis

Materials	Max Fuel Used	Avg Fuel Used
_____	_____	_____
_____	_____	_____
_____	_____	_____

- Location, number of burners and capacity of each burner. Please use drawing if available.
- General description of current control method/technology for PM and PM10 at these operations and its effectiveness
- General description of current monitoring for PM and PM10
- Operating schedule: _____
- Estimated emissions _____
- AER Reported (Yes/No) _____

Roadways (Paved and Unpaved Roads)

- Identify haul roads, paved roads, unpaved roads and estimate length of each type. Please use drawing if available.
- Number of trucks or other transportation methods traveled on unpaved and paved roads and size
- General description of current control method/technology for PM and PM10 (e.g. cleaning and cleaning schedule of inside roadways, trackout control of outside paved roads) and its effectiveness
- General description of current monitoring for PM and PM10
- Operating schedule: _____
- Estimated emissions _____
- AER Reported (Yes/No) _____

Attachment 2

Control Technology and Cost Information

Please provide information listed below, and include other necessary information to assess the effectiveness of current control measures and provide information for potential future applications.

Baghouses

For each source, or a combination of sources, that currently utilizes baghouse as the control technology for particulate matter, please provide:

- Brief description of baghouse including but not limited to the following:
 - baghouse manufacturer _____
 - baghouse installation date (or last major modification date) _____
 - overall dimensions _____
 - number of bags _____
 - type of bags _____
 - total cloth filter area _____
- Information used in the design of each baghouse including but not limited to the following:
 - volumetric gas flow rate _____
 - air-to-cloth ratio _____
 - pressure drop _____
 - variations in the gas stream temperature _____
 - particle size distribution of the inlet gas _____
 - moisture content _____
 - acid dew point _____
 - PM and PM10 control efficiency _____
- Description of current monitoring practice for PM and PM10 such as visible emissions monitoring, stack testing, pressure drop
- Description for current maintenance practice for the baghouse such as method of cleaning, frequency of cleaning, replacing bags, and other maintenance practice
- Please provide equipment drawing and operation and maintenance manual

- Costs. Indicate if information is confidential.
 - Equipment cost _____
 - Installation cost _____
 - Annual operating cost _____

Other types of control (e.g. total enclosure, cover, mist eliminator, cyclone, street sweeper, water or chemical stabilizer, water spray)

Please provide:

- Brief description of the control equipment or technique including but not limited to the following:
 - equipment manufacturer _____
 - installation date (or last major modification date) _____
 - overall dimensions _____
 - particulate control efficiency _____
- Parameters used in the design of the control equipment or technique
- Description for current monitoring practice for PM and PM10 and maintenance practice. Please provide equipment drawing and operation and maintenance manual if available.
- Costs. Indicate if information is confidential.
 - Equipment cost _____
 - Installation cost _____
 - Annual operating cost _____